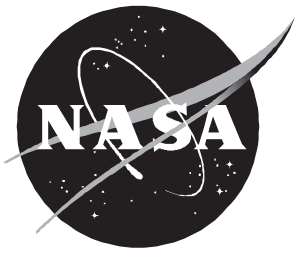
NASA Contractor Report 201743



Pilot Evaluation Comments During Selected Maneuvers From Flight Tests of the HARV NASA-1A Control Law

Jessie C. Yeager

August 1997

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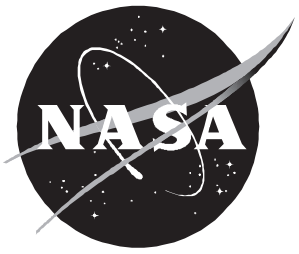

Pilot Evaluation Comments During Selected Maneuvers From Flight Tests of the HARV NASA-1A Control Law

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Abstract

Under the NASA High-Alpha Technology Program the High-Alpha Research Vehicle (HARV) was used to conduct flight tests of advanced control effectors, advanced control laws, and high-alpha design guidelines for future super-maneuverable fighters. The HARV is a pre-production F/A-18 airplane modified with a multi-axis thrust-vectoring system for augmented pitch and yaw control power. Handling-Qualities flight testing at the Dryden Flight Research Center (DFRC) for the NASA-1A Control Law was conducted in the spring of 1994. Pilot comments during actual flight test maneuvers and following the maneuvers will be useful in evaluation of control law performance. Audio files containing pilot comments were retrieved from the DFRC data system and stored on the Dynamics and Control Branch (DCB) computer complex at NASA Langley Research Center (LaRC), and pilot comments were transcribed for use as a control law evaluation tool. This report briefly describes the multi-step task used to transcribe these comments and presents transcriptions of actual pilot communications for selected maneuvers using the NASA-1A control law. Documentation includes flight information, maneuver information, time intervals for which comments were retrieved, pilot comments, and pilot Cooper-Harper ratings.

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Pilot Evaluation Comments During Selected Maneuvers from Flight Tests of the HARV NASA-1A Control Law

Introduction

Future super-maneuverable fighters will need to employ rapid nose-pointing maneuvers to be successful in air combat. These maneuvers compared with those of current fighters will require that the aircraft operate throughout significantly expanded angle-of-attack and sideslip ranges and that the aircraft have unprecedented maneuvering capabilities, particularly at low speed and high angles of attack. However, the effectiveness of conventional aerodynamic control effectors is often inadequate to meet these requirements under the conditions of high angle of attack and low dynamic pressure. One of the key technologies required to achieve this maneuverability is advanced high-angle-of-attack controls. Elements of this technology include control effectors to produce angular accelerations; digital flight control laws which effectively utilize these control effectors to achieve the desired stability, maneuverability, and handling qualities; and guidelines to effectively integrate elements of this technology during the design process (ref. 1).

Under the NASA High-Alpha Technology Program research was conducted in those technology areas. The High-Alpha Research Vehicle (HARV) was used to conduct flight tests of advanced control effectors, advanced control laws, and high-alpha design guidelines. The flights were conducted at the Dryden Flight Research Center (DFRC).

The High-Alpha Research Vehicle (HARV) is a pre-production F/A-18 airplane modified to incorporate a multi-axis thrust-vectoring system for augmented pitch and yaw control power. The highly instrumented HARV is equipped with a research flight computer in which advanced flight control laws can be implemented. This control system is known as the Research Flight Control System (RFCS).

Control laws to utilize the thrust-vectoring system were designed and implemented in the RFCS (refs. 2 - 4). Flight testing of the NASA-1A control law began in May 1994 and continued during June 1994 (ref. 5). During the flight tests, pilots were asked to fly a test matrix of maneuvers guided by instructions on the flight cards. The pilot was asked to comment on maneuver execution and to evaluate the maneuver using Cooper-Harper and Pitch Recovery rating scales. The comments will be utilized at the NASA Langley Research Center (LaRC) in evaluating control law performance, evaluating aircraft dynamics, and validating design guidelines. Recorded voice transmissions between the pilot and the flight Test Director were digitized at DFRC. These digitized audio files were retrieved from the DFRC data system and stored on the Dynamics and Control Branch (DCB) computer complex at LaRC for subsequent transcription.

The purpose of this report is to present documented comments made during and immediately after the flight maneuvers by the pilot to communicate his evaluation of the NASA-1A Control Law. This report also includes information concerning the flights, the maneuvers, and the time intervals for which pilot comments were transcribed.

Handling-Qualities Flight Tests

Objectives

The research objectives of the HARV handling-qualities flight tests were to improve understanding of high-angle-of-attack handling qualities, create a high-angle-of-attack handling qualities database, develop appropriate research evaluation maneuvers, evaluate high-angle-of-attack handling-qualities guidelines and criteria, and evaluate and validate control-law design methodologies for high angle of attack (ref. 6). Pilot comments and ratings were important elements in achieving these objectives.

Maneuvers

A number of maneuvers, some newly developed as part of the High-Alpha Technology Program, were flown during the HARV NASA-1A handling-qualities flight tests. The selected transcribed NASA-1A maneuvers discussed in this report are listed in Table 1. Brief pictorial descriptions of the maneuvers are included in Appendix A. Additional descriptions of the maneuvers can be found in references 6 and 7. Other maneuvers flown during NASA-1A flight tests, such as stick doublets and system identification maneuvers, are not handling-qualities maneuvers and are not discussed in this report.

Table 1. NASA-1A Handling-Qualities Maneuvers

Alpha Capture from $\alpha = 20°$
60° - 10° Alpha Capture
Pull-Up Push-Over
360° Roll/Heading
Loaded Roll Capture
G/Heading Capture
High-α Longitudinal/Lateral Tracking

Test Procedures

The pilot flew the maneuvers using instructions on the flight cards, instructions received from discussion at the pre-flight briefing, and his experience gained from piloted simulation. In most cases the maneuvers had been practiced in the Dryden piloted simulator and/or in the Langley Differential Maneuvering Simulator (DMS) before flight testing.

An example flight card for a handling-qualities maneuver is shown in Appendix B. Figure B1 is flight card 008 for Flight 258 (ref. 8). As the example flight card indicates, the issues to be addressed, questions to be answered, and ratings to be given by the pilot were normally explicitly called out on the card. Usually, the pilot addressed each of these points sequentially immediately following completion of the maneuver, including the assignment of Cooper-Harper Ratings and Pitch Recovery ratings. However, discussion of each point was not always practical or appropriate. For the reader's convenience, a Cooper-Harper Rating scale and a Pitch Recovery Rating scale (refs. 9 - 10) are included in Appendix C.

Pilot Comments

Overview

Pilot comments from 36 selected handling-qualities maneuvers flown during flight tests of the NASA-1A Control Law have been transcribed onto Pilot Comment Forms, and the forms are included in this section. The selected maneuvers were from Flights 256 through 262.

Transcription Process

The process to transcribe pilot comments recorded by the DFRC flight test team during HARV NASA-1A flight tests was a multi-step task. Briefly, the steps of the process are listed below.

1. Recorded voice transmissions from the pilot were converted to digital audio computer files by the DFRC Controls Team.

2. Audio files were retrieved from the DFRC computer to the LaRC DCB computer cluster via FTP (File Transfer Protocol).

3. Template pilot comment forms were prepared appropriate to the various maneuvers.

4. Audio files were transcribed using the Mxv software on the DCB Sun computers. The graphical interface capability of this software allowed the transcriber to select portions of the pilot comments for repeated replay when comments were difficult to decipher.

5. Transcribed pilot comments were entered into the comment section of the appropriate template, and the topics of the template were arranged to preserve the chronological sequence of the recorded comments.

6. The flight information and plot sections were completed using flight data, data from flight cards, and DFRC-published flight reports.

Punctuation marks were used to draw special attention to occurrences recorded on audio files. Long pauses in communication were indicated with ellipses. When comments were not understandable, the notation "???" was used. If no response to a topic or requested rating was made by the pilot, the words "Not Available" were used.

Template Format

The general format used to present pilot comment files is described below. Each Pilot Comment Form includes four basic types of information.

Flight information. - The upper left portion of the Pilot Comment Form contains general flight information, initial conditions for the maneuver, and the type of maneuver that was being flown. Some of the information was obtained from DFRC flight reports (refs. 8, 11, and 12). Data include flight number, card number, control law version, type of maneuver, pilot name, and date of flight.

Plot. - The upper right portion of the template contains a time-history plot of the HARV angle of attack (AOA) during the maneuver. The labels on the plot indicate which flight number, flight card, and processed flight data file (from flight data files on the DCB computer complex) were used to produce the plot.

Pilot Comments. - The larger portion of the template contains pilot and Test Director comments made during the maneuver and immediately after the maneuver during pilot evaluation. However, the comments did not always follow a template sequentially. The comments were chronologically transcribed in appropriate topics and the template topics were rearranged to follow the recorded sequence of the pilot's comments. When a topic was not addressed, an entry "Not Available" was made. Cooper-Harper ratings and Pitch Recovery ratings were included if available.

Times. - The last portion of the template contains a table of times for the maneuver as provided by DFRC. The times indicate beginning and ending times for the maneuver and beginning and ending times for the pilot comments in DFRC local time.

Transcribed Comments

This section presents completed Pilot Comment Forms with the transcribed pilot comments and ratings for 36 handling-qualities maneuvers from flight tests of the NASA-1A Control Law. Table 2 lists maneuver information. The "Page no." column is provided for the convenience of the reader and refers to the page number in this report where the Pilot Comment Form is located.

Table 2. Transcribed NASA-1A Maneuvers

Flt	Flt Card no.	Desired (actual) initial conditions		Maneuver	Page no.
		Mach	AOA		
256	4a	(0.62)	5°	360° roll-capture	6
257	6a2	(0.41)	15°	360° roll-capture	7
	7a	(0.42)	20°	30° alpha-capture	8
	10a	(0.34)	25°	360° roll-capture	9
	11a	(0.29)	20°	45° alpha-capture	11
	11b2	(0.19)	45°	10° alpha-capture	12
258	8a2	0.5	30°	Long/lateral tracking	13
	11a	(0.37)	20°	45° alpha-capture	15
	12a	(0.20)	45°	10° alpha-capture	16
	12Aa	(0.30)	15°	Pull-up/push-over	18
259	1Aa	(0.34)	25°	360° roll-capture	19
	3a	(0.22)	45°	360° roll-capture	20
	3b	(0.36)	20°	60° alpha-capture	21
	4a	N/A[(1)]	60°	10° alpha-capture	22
	4c	N/A	60°	10° alpha-capture	23
	5a	(0.36)	20°	Pull-up/push-over	24

[(1)] N/A - Not available

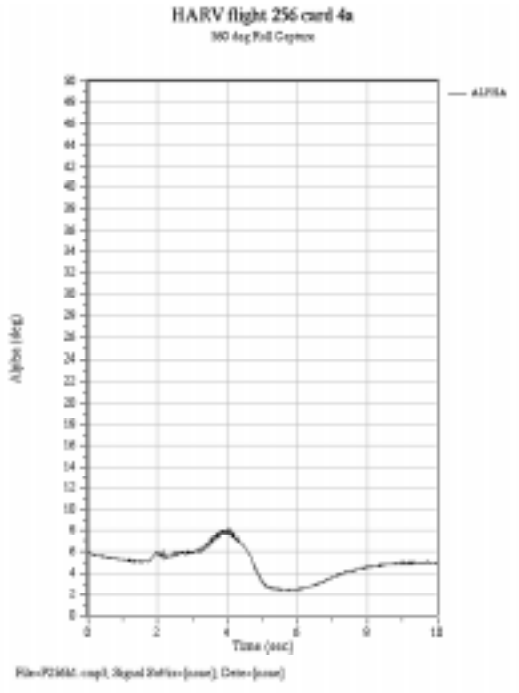
Table 2. Concluded

Flt	Flt Card no.	Desired (actual) initial conditions		Maneuver	Page no.
		Mach	AOA		
260	5d	N/A[1]	60°	360° roll/heading-capture	25
	6a	(0.28)	35°	Pull-up/push-over	26
	7a	0.6	2 g's	2g/heading-capture	27
	7b	0.6	(7°)	15°alpha-capture	28
	8a	(0.25)	40°	Pull-up/push-over	29
	9a	0.6	3 g's	3g/heading-capture	30
	9b	0.6	(7°)	30°alpha-capture	31
	10a	N/A	55°	Pull-up/push-over	32
261	11a	0.6	15°	Loaded roll	33
	12a	0.6	(8.5°)	45°alpha-capture	34
	12b	0.6	5°	Loaded roll	35
	13a	(0.56)	15°	Pull-up/push-over	36
	14a	0.6	25°	Loaded roll	37
	15a	0.6	60°	60°alpha-capture	38
262	2ab	N/A	55	360° roll/heading-capture	39
	3a	0.6	15°	Loaded roll	41
	4a	(0.53)	30°	Pull-up/push-over	42
	5a	0.6	35°	Loaded roll	43
	6a3	(0.67)	20°	Pull-up/push-over	44
	7a	0.6	20°	Loaded roll	45

[1] N/A - Not available

HARV HQ Comment Card

Flight: 256
Card #: 4a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 850/Smith
Mach No: .62
Altitude: 25000
Desired AOA: 5°
Maneuver: 360° Roll Capture
Actual AOA: 5°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 03Jun94



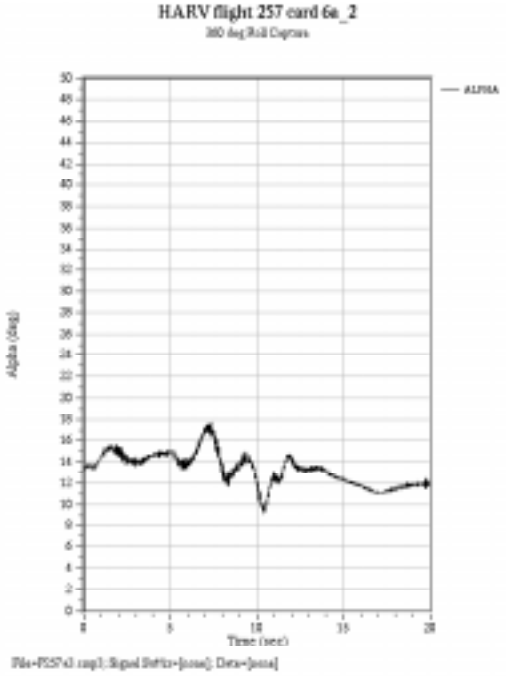
Pilot Comments: [Pilot] Here comes the roll.
(snip to post-maneuver comments)
Comments on:
Alpha Control During Roll: [Pilot] Yeah, we lost the AOA halfway through the maneuver, so I don't know whether...exactly how well ... it uh...did... I did not feel any bumping or any g increase on the airplane.
Roll Rate: [Pilot] Roll rate was what I would classify as moderate. Was not exceptionally fast.
Bank Angle Capture: [Pilot] The...uh...bank angle capture was quite easy, because the roll rate was not that high, and you can check the the strips. ...I don't think I brought the controls out too early and slowed the roll rate down significantly before the zero bank angle.
Cooper-Harper Rating:
Longitudinal CHR: Not available
Lateral/Dir CHR: 2
Other Comments: [Pilot] Cooper-Harper-wise...Pushing rudder ...it increases the bank angle in the wrong direction. Ok, it's controllable. ...uh...uh...It's adequate. Satisfactory without improvement? Uh... I would say ... uh... yes, and I will give it a good 2...Cooper-Harper 2. Roll performance is, however, slightly sluggish. Might just be at this condition. Let me disengage here. [Test Director] Roger that and copy that. I understand that the alpha control during the roll ...uh... No Cooper-Harper rating on that. [Pilot] Well, I didn't... I couldn't observe it cause I was looking in the HUD, and it went away, see. [Test Director] Ok...uh...Ok, that's acceptable. [Pilot] My impression was the first half of the maneuver, it was pretty much within about a degree. So it appears to have met the desired critera. At least halfway through the maneuver, until I lost... I lost the steering. [Test Director] Ok...Polling the control room for any further comments. Ok, good maneuver. You were +/- 2 on alpha and +/- 8 on the phi-captures. So you were within bounds on either one.

Times:

Maneuver Times: [begin-end]	09:38:25 - 09:38:34
Comment Times: [begin-end]	09:38:34 - 09:41:05

HARV HQ Comment Card

Flight: 257
Card #: 6a_2
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Ishmael
Mach No: .41
Altitude: 25000
Desired AOA: 15°
Maneuver: 360° Roll Capture
Actual AOA: 15°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 03Jun94



Pilot Comments: [Pilot] OK, here we go. ...
(snip to post-maneuver comments)
[Test Director] Ok, looked good. Check the strips. ...We'll take your comments.

Comments on:

Alpha Control During Roll: [Pilot] Same comments on the angle of attack...uh...Looked like I was a little more successful with the forward stick...keeping it within about...uh...2 degrees is my estimate...Let's see...uh...Controllable?...Yes. Adequate with tolerable pilot workload?...I would say yes...Satisfactory without improvement?...I would say no...I'd give it a 4...for requiring pilot compensation to try...to try to hold the angle of attack during roll. [Test Director] Copy.

Bank Angle Capture: [Pilot] ...As far as the bank angle...controllable? Yes. Adequate? Yes. Satifactory without improvement? ...I would say yes. I would give it a uh...give it a 2.5. [Test Director] Copy 2.5 and a 4 for alpha. Comment on roll rate on the last one.

Roll Rate: [Pilot] Roll rate was moderate...I guess, oh, ... maybe ... I don't know, it's, ah, kind of a performance issue. It's adequate for...for most purposes.

Cooper-Harper Rating:

Longitudinal CHR: 4
Lateral/Dir CHR: 2.5

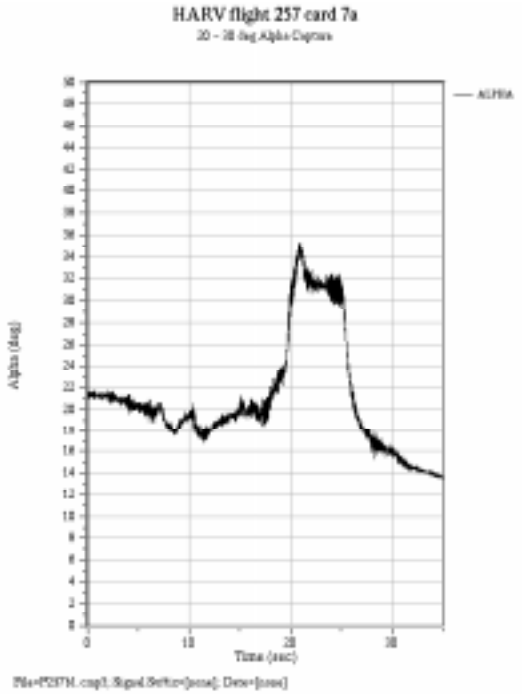
Other Comments: [Test Director] Copy the above. Polling control room for any further comment. Ok, alpha was +/- 2. Phi was +/-8...well within the desired criteria. On to card 7.

Times:

Maneuver Times: [begin-end]	11:27:52 - 11:28:01
Comment Times: [begin-end]	11:28:01 - 11:29:38

HARV HQ Comment Card

Flight: 257
Card #: 7a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Ishmael
Mach No: .42
Altitude: 27000
Desired AOA: 20°
Maneuver: 20°-30° Alpha Capture
Actual AOA: 24°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 03JUN94



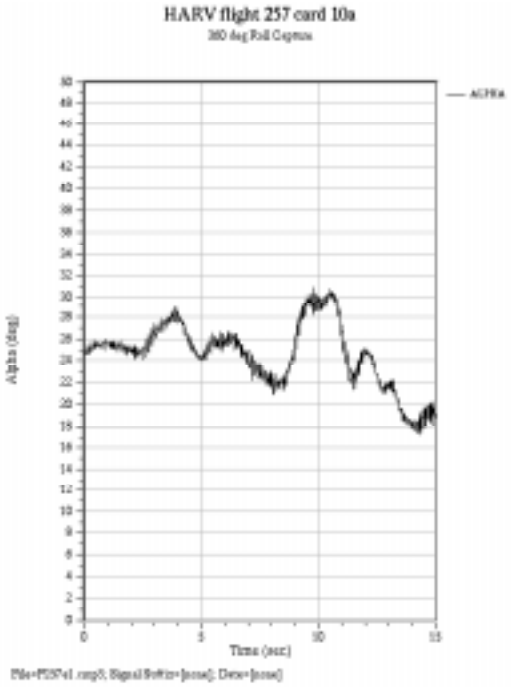
Pilot Comments: : [Pilot] Banking. Max AB and now. [Test Director] Recover. Ok. We'll check the strips, while you talk to us about it.
(snip to post-maneuver comments)
[Pilot] Ok, the alpha capture went pretty smoothly that time. I...my still impression is that the airplane is sensitive. ...Uh, but I felt comfortable putting in the size of input that I did; and I felt that it was aggressive enough. The...uh... I got lucky and it only overshot to about 2 degrees ... to about 32 degrees and then it settled right to 30.
Comments on:
Pitch Rate: [Pilot] Pitch rate was moderate, I would say.
Time to Capture: [Pilot] And time to capture was ... I don't know ... 2 to 3 seconds, I guess. Get a rating here in a minute...
Control Lead Objection: [Pilot] Control lead objection? Wasn't really any objection on this one ...uh ... uh ... I just pulled back on stick and I must have guessed just right and got it right where it should have been for that particular angle of attack. [Test Director] Copy that. No pitch recovery rating record. And we need your Cooper-Harper and that's it. [Pilot] Ok...it's controllable. Adequate performance with ... tolerable workload? ... Yes. It's a strange airplane. ... You push on the rudder opposite the way you want to roll. Satisfactory without improvement? I would say yes. I would give it a, ah, 2.
Cooper-Harper Rating:
Longitudinal CHR: 2
Confidence Rating: Not available
Pitch Recovery Rating Scale: Not available
Other Comments:

Times:

Maneuver Times: [begin-end]	11:31:38 - 11:31:50
Comment Times: [begin-end]	11:31:50 - 11:33:36

HARV HQ Comment Card

Flight: 257
Card #: 10a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Ishmael
Mach No: .34
Altitude: 25000
Desired AOA: 25°
Maneuver: 360° Roll Capture
Actual AOA: 25°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 03Jun94



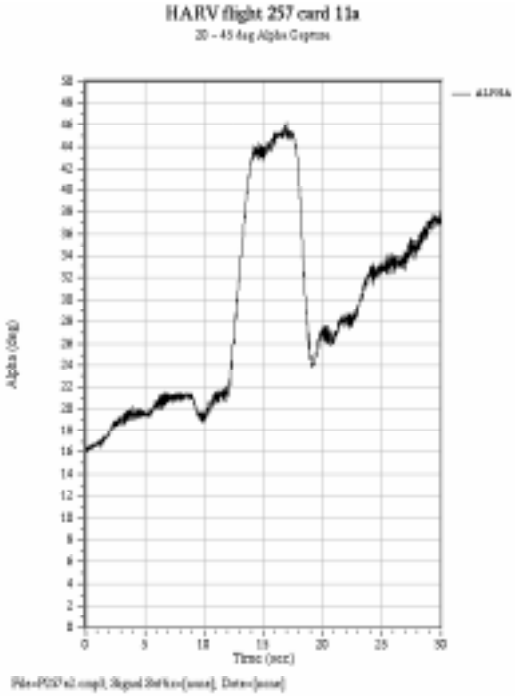
Pilot Comments: [Test Director] Control room's ready. [Pilot] OK, and ...here we go. ... AOA increased. ... Pretty tough to control the AOA during that. [Test Director] ...You were Ok. Recover.???
(snip to post-maneuver comments)
[Test Director] OK.
Comments on:
Alpha Control During Roll: [Pilot] OK. AOA control during roll was difficult ... AOA increased initially. ...Made a correction and then ...uh, I can't remember exactly what I did. ...But, uh, I think I got a little bit low towards the end.
Bank Angle Capture: [Pilot] The bank-angle capture, I might have led it just a little bit. The roll rate is fairly low, so that the capture ... uh... the capture's not difficult, and uh, doesn't really pose a problem.
Roll Rate: [Pilot] The roll rate was ... I'd say slow to moderate. [Test Director] Copy. O.K., good. Need some Cooper-Harpers on alpha control during roll and bank angle capture.
Cooper-Harper Rating:
Longitudinal CHR: 8
Lateral/Dir CHR: 2
Other Comments: [Pilot] Well, ... that's a question mark right there. I will say that it is ... uh ... Well, it's a judgment on whether you think I stayed within adequate criteria or not here, which I don't have a very good judgment for. My impression is that I did not control it very well. I will uh ... I didn't think it was a ... well, I'm going to say it was uh ... We did not get adequate performance with maximum tolerable pilot workload; so, I will say that we'll give it an 8. [Test Director] Copy that. [Pilot] And on roll control bank angle capture. Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes. I would give it a , uh, a 2. [Test Director] Copy that above. Let's go ... fuel transfer tank 1 inhibit, please. And checking control room for further comments. On checking the strips, you were +/-3 on alpha, so you fell just outside the desired band. And on the roll rate, you did the capture at a +/- 5, so you were well within the desired band there. Would you like to re-rate either one of those? [Pilot] No, I uh ... even though we got adequate performance, ... I think if the objective is to control it and it takes a lot of pilot effort to do that. [Test Director] Roger that. Copy that.

Times:

Maneuver Times: [begin-end]	11:45:20 - 11:45:31
Comment Times: [begin-end]	11:45:31 - 11:48:30

HARV HQ Comment Card

Flight: 257
Card #: 11a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Ishmael
Mach No: .29
Altitude: 27000
Desired AOA: 20°
Maneuver: 20°-45° Alpha Capture
Actual AOA: 21°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 03JUN94



Pilot Comments: [Pilot] ??? 45 and ... Max power [Test Director] Max Power. [Pilot] Here we go. [Test Director] Ok, roll out before the push.
(snip to post-maneuver comments)
[Pilot] Ok. Ok. Let's see. Alpha capture uh ... Not the most aggressive maneuver that I've ever done. [Test Director] Uh, Jim, could we get these over UHF, Sir. [Pilot] Yeah. Ok, the alpha capture, you'll have to read the comments to me cause I can't come by a Cooper-Harper scale here. [Test Director] Ok, we're looking for comments on pitch rate and time to capture for the first alpha capture.

Comments on:

Pitch Rate: [Pilot] My pitch rate was slow, because ...uh, ... not being totally used to the control system, I didn't know what to expect. (Pull back,???) what I expected to get further response, and it was a little slower than I thought it was going to be. The uh, ...I just happened to guess on stick position correctly. I got about 43 degrees and uh, was able to stabilize it out at 45 without, uh, an overshoot actually. [Test Director] Roger that, and uh, on the time to capture?

Time to Capture: [Pilot] Time to capture was slow, so probably on the order of about, uh, ... 3 to 4 seconds. [Test Director] Ok, and we'll like Cooper-Harper rating on the, uh, capture. [Pilot] I would say, that I probably didn't do exactly the task ... the task that was, uh, appropriate. I could have been more a little more aggressive. Was controllable? Yes. Adequate performance? Yes. Satisfactory without improvement? ...Uh ... I will say yes for this maneuver. But I ... like I say, the maneuver's in question. I would say a 2 on that one. [Test Director] Copy that and uh ...Control lead objection for this task?

Control Lead Objection: [Pilot] It was none required, since I just happened to guess the stick position properly. [Test Director] Copy that. None required.

Cooper-Harper Rating:

Longitudinal CHR: 2

Confidence Rating: Not available.

Pitch Recovery Rating Scale: Not available

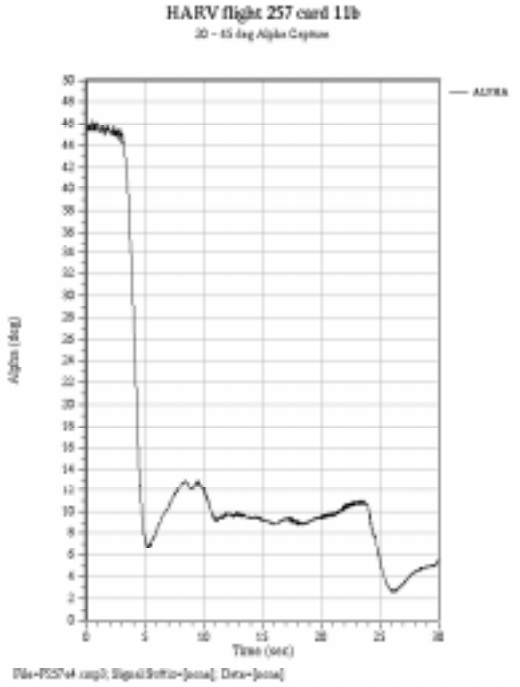
Other Comments:

Times:

Maneuver Times: [begin-end]	11:51:30 - 11:51:39
Comment Times: [begin-end]	11:53:57 - 11:55:33

HARV HQ Comment Card

Flight: 257
Card #: 11b_2
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Ishmael
Mach No: .19
Altitude: 27000
Desired AOA: 45°
Maneuver: 45°-10° Alpha Capture
Actual AOA: 45°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 03JUN94



Pilot Comments: [Pilot] Ok. [Test Director] We're ready. [Pilot]... and ... Here we go. [Test Director] We're looking for 250 knots. [Pilot] Roger.
(snip to post-maneuver comments)
[Test Director] Ok, let's shift our gaze to the 45 to 10 capture. Uh...let's talk about the second one, or do you want to talk about them separately?
Comments on:

Control Lead Objection: [Pilot] Well, they're both exactly the same. I, uh, just did the open loop task of, uh, moving the stick to, uh, my best guess for the, uh, for the angle of attack. And I guessed right both times. And it went right down to 10 degrees and stayed right there. [Test Director] Roger that. Uh, comment on pitch rate during the task?

Pitch Rate: [Pilot] Uh ... Pitch rate was adequate. ... It was not, uh, the most ... the fastest pitch rate, but it was certainly adequate for the task; and I'm not sure I'd would want to do it a lot faster. Uh ... anyways, though, it was not full stick. [Test Director] Ok, and we'd like a Cooper-Harper on that alpha capture. [Pilot] Ok. It was controllable? Yes. Adequate? Yes. Satisfactory? Yes. Uh, I'd give it a 2. [Test Director] Copy a 2. Now, let's turn our attention to the restabilization. Uh, comment on the time and altitude to recover and your expectations.

Time to Capture: [Pilot] Ok. It was about what I expected. Uh, it's not a real great closed-loop task. I just left the nose 30 degrees nose low, which is where I captured the 10 alpha. And, uh, the airplane accelerated out, and I led it properly to about right at 250 knots level, uh, which is about the way that most people probably do that. Uh, the time was ... uh, ... uh ... Performance of the airplane seemed to be adequate. I don't know what the time was ... uh , or anything.

Cooper-Harper Rating:

Longitudinal CHR: 2

Confidence Rating: Not available

Pitch Recovery Rating Scale: Not available

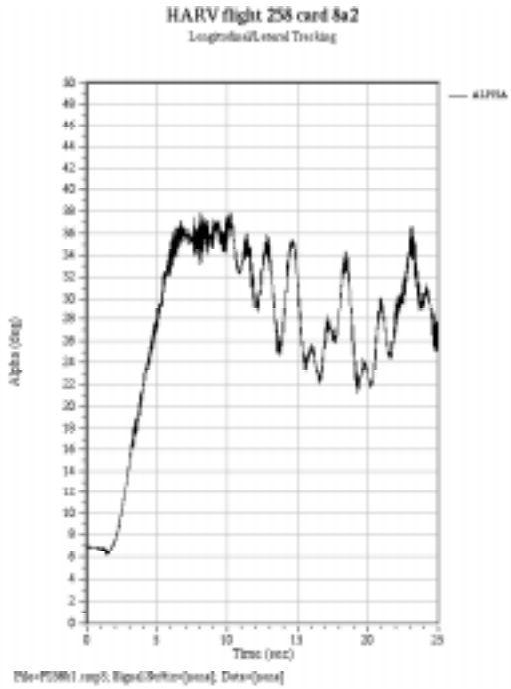
Other Comments:

Times:

Maneuver Times: [begin-end]	11:53:05 - 11:53:12
Comment Times: [begin-end]	11:55:33 - 11:57:05

HARV HQ Comment Card

Flight: 258
Card #: 8a2
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/McMurtry
Mach No: .45
Altitude: 25000
Desired AOA: 30°
Maneuver: Long/Lat Tracking
Actual AOA: 22° - 36°
Reticle/Depression:
12.5 mil/80 mil
Desired: 50% of time on target
Adequate: 10% of time on target
Date: 03Jun94



Pilot Comments: [Pilot] Clear maneuver. [Test Director] 30 35 35 35 30 ...[Pilot] You could see that PIO. Jesus! [Test Director] 25 30 [Pilot] Heh, heh (laughter). Hey, let's try [Test Director breaks in] 30 [Pilot continues] ... something lateral here. Knock it off.
(snip to post-maneuver comments)
[Pilot] Ok, I really didn't get everything done because the longitudinal axis was so bad. It was an increasing PIO. I think, in there, Keith could probably get a lot of longitudinal doublet data. Physically, I couldn't get the pipper settled on the target at all. Every time I tried to make a correction, the... uh... the PIO increased in amplitude ... so ... uh, I'll give that one a pilot rating if you want. [Test Director] Uh...Yeah, let's go ahead and talk about it. Uh, might as well get the comments down here.

Comments on Attitude Control:

Undesirable Motion: [Pilot] Ok, the undesirable motions? Uh, first of all, I was not super aggressive in trying to put the pipper on target. Uh,... but I did try to get it there reasonably, so that we ...uh... would ... get... I was up there about 35 AOA or so, which wasn't too bad in terms of about the average. [Test Director] Roger that. [Pilot] Undesirable motion was that we had an increasing amplitude PIO. Uh...probably on the order of ... uh ... would say towards the end about 10 degrees of attitude.

Predictability: [Pilot] Uh...Predictability? Was unpredictable. Every time I tried to stop it, I just made it worse.

Initial Response: [Pilot] Initial response? Was...Uh...was adequate ... uh, and responsive. Difficulty with the gross acquisition was getting the pipper stopped. Uh, even when I tried... to, uh... I got it initially a little bit behind him, when I tried to move it up to him ???...uh, very aggressively at all, it ended up getting that PIO.

Compensation Techniques: [Pilot] Compensation techniques? Uh...Uh...Well, I'm not aware of any. The only thing I could suggest is letting go of the stick.

Roll Performance: [Pilot] Roll performance was not evaluated. Uh, I did try one, but the longitudinal axis was really the main player and it was ...uh, overshadowing the ... all the rest of the evaluation.

Aggressiveness Effects H/Q: [Test Director] And can you comment on aggressive effects on HQR? [Pilot] Yeah. I don't think that I was all that aggressive to tell you the truth. It wasn't like I was in there really stirring.the...stirring the pot real... real hard.

Comments on Feel System: [Test Director] Understand. Ok. We'll take your feel system comments, Sir.

Forces: [Pilot] OK. Forces? Uh... seem to be Ok.

Control Motion: [Pilot] Control motion? Not excessive.

Harmony: [Pilot] Harmony? Uh... I didn't really get to evaluate that very well. [Test Director] Give me a Cooper-Harper.

Nonlinearity: [Pilot] Linearity? Uh, I can't comment on that.

Cooper-Harper Rating: : [Pilot] Cooper-Harper rating. Controllable? I would say No. So we give it a 10. [Test Director] Copy that. And did you get a chance to look at lateral at all? [Pilot] Uh...No, uh, I got so caught up with the longitudinal, I didn't... didn't really have time.

Longitudinal CHR: 10

Lateral/Dir. CHR: Not available.

Confidence Rating:

PIO Rating: Not available.

RPC Rating: Not available.

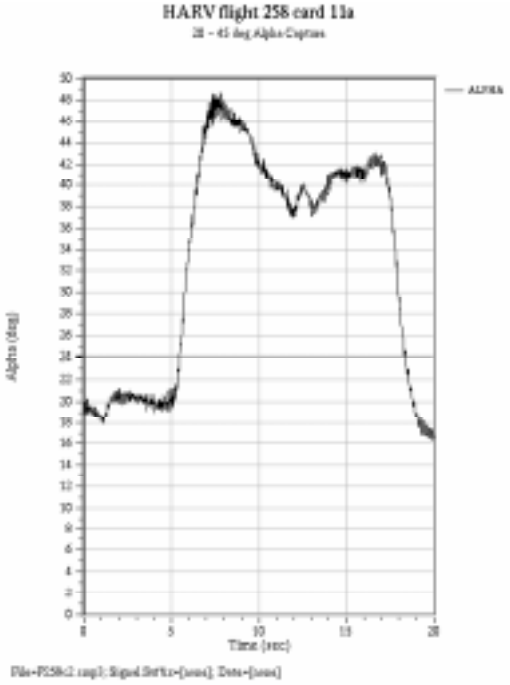
Other Comments

Times:

Maneuver Times: [begin-end]	13:44:02 - 13:44:34
Comment Times: [begin-end]	13:44:34 - 13:48:40

HARV HQ Comment Card

Flight: 258
Card #:11a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/McMurtry
Mach No: .37
Altitude: 27000
Desired AOA: 20°
Maneuver: 20°- 45° Alpha Capture
Actual AOA: 20°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 03Jun94



Pilot Comments: : [Pilot] And ... going for it. Ok, rolling out. [Test Director]... Ok. Uh, recover. (snip to post-maneuver comments)
[Pilot] Ok, that one, I pulled back, ... uh, it was kinda a 2 step...uh... I pulled back. It was kinda a 2 step ... uh, stick application. Uh, the first I pulled it back an inch or so...I didn't quite get the response I exactly wanted, so I pulled it back a little farther and it turned out ... I guessed pretty well on the second part, cause I got 45 pretty much right on. [Test Director] Copy that.
Comments on:

Control Lead Objection: [Pilot] So there wasn't any control lead objection, because, uh, it's kinda an open-loop maneuver, so unless you ... uh ... Unless you demand that the guy goes full aft stick, and then tries to stop it at 45, ... uh ... with this alpha command, it uh, just pretty much goes to where you want it to, as long as you sorta have a good guess as to where that is. [Test Director] Copy that. Comments on pitch rate and, uh, how fast it got there...and your expectations.
Pitch Rate: [Pilot] yeah, the pitch rate was, uh, adequate. Was, uh, about where I wanted.
Time to Capture: [Pilot] The time to capture was good. Uh ... was probably 2 to 3 seconds. A little bit faster than this morning's. [Test Director] Roger that. Now we'll take Cooper-Harper.

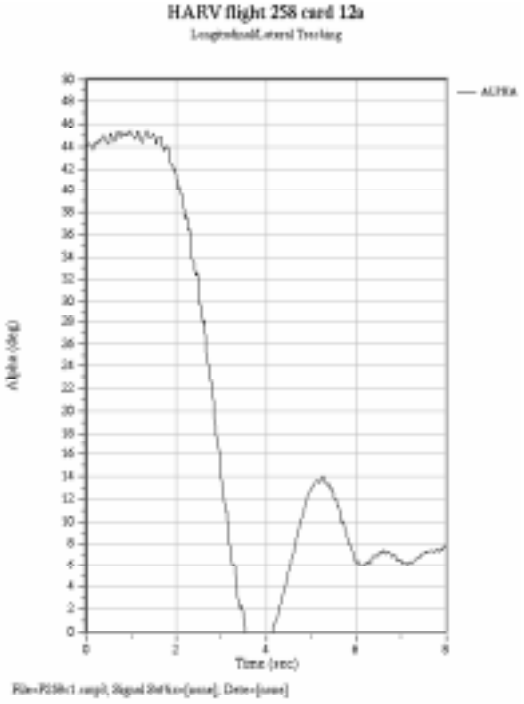
Cooper-Harper Rating: [Pilot] Controllable? Yes. Adequate? Yes. Satisfactory without improvement? I would say, uh, Yes, based on what I saw. And I give it a 2.
Longitudinal CHR: 2
Confidence Rating:
Pitch Recovery Rating Scale:
Other Comments:

Times:

Maneuver Times: [begin-end]	13:52:35 - 13:52:44
Comment Times: [begin-end]	13:52:44 - 13:54:15

HARV HQ Comment Card

Flight: 258
Card #:12a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/McMurtry
Mach No: .20
Altitude: 27000
Desired AOA: 45°
Maneuver: 45°- 10° Alpha Capture
Actual AOA: 45°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 03Jun94



Pilot Comments: : [Pilot] And,...Here we go. [Test Director] Recovered.
(snip to post-maneuver comments)
[Pilot] Ok. ...My technique there, was ... I, uh, bounced it off the forward stop, and, uh, then I tried to relax it just a little bit based on the, uh, sorta the DMS technique. I, uh, overshot just a little bit, and you saw that the airplane kinda rebounded. Uh, I don't know exactly what alpha it got to minimum, but it did rebound a little bit. I pushed a little bit farther forward on the stick, and I ended up right...right about 10. One overshoot. Uh... the airplane is sensitive to those control reversals. It digs in pretty quick, uh, if you get the stick aft to, uh, where you want it to be for the 10 degree alpha.

Comments on:

Pitch Rate: [Pilot] Pitch rate was good. Uh, time, altitude ... Uh, we didn't really talk about the altitude to recover, but, uh, ...

Time to Capture:. [Pilot] ... the time was good. A little bit ... probably a little bit quicker maneuver than doing it ... doing the DMS technique. [Test Director] Copy that. Control lead objections?

Control Lead Objection: [Pilot] Well, the only objection is that, when you, uh, when you move the stick...uh, aft... after a plan to pull forward; if you miss guess where to put it, then you just kinda dig in on the airplane, and the angle of attack will, uh, oscillate a bit. Uh, I believe, uh, that there could be a potential for PIO, uh ... doing that.

Cooper-Harper Rating: [Test Director] Copy that. And we'll take your Cooper-Harper an the alpha capture. [Pilot] Ok. It's controllable? Yes. Adequate, uh, ... with pilot workload? I would say, based on what I saw there, Yes. Satisfactory without improvement? I would give it a 5. Based on the fact that, uh, you get get this ... The airplane is sensitive in pitch, and, uh, so it is easy to miss guess exactly where to put the stick, and then you sorta get into a PIO, uh, situation.

Longitudinal CHR: 5

Confidence Rating: Not available.

[Test Director] Copy that, and if you'll get out your pitch rating scale, uh, we'll take a pitch recovery rating on the pushover. [Pilot] I would say, uh, ... Recoverable? Yes. Adequate? Yes. Recovery highly desirable? Uh, ... I would say ... In the initial response. Yes. And I would give that a 1.

Pitch Recovery Rating Scale: 1

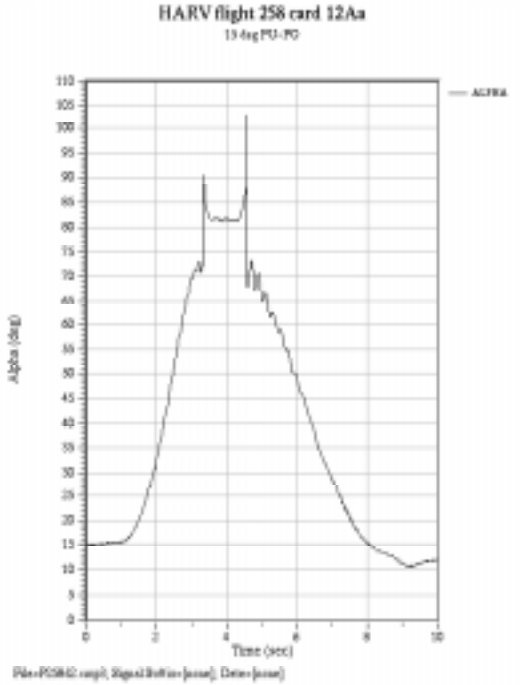
Other Comments:

Times:

Maneuver Times: [begin-end]	13:55:58 - 13:56:11
Comment Times: [begin-end]	13:56:11 - 13:58:51

HARV HQ Comment Card

Flight: 258
Card #: 12Aa
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/McMurtry
Mach No: .30
Altitude: 27000
Desired AOA: 15°
Maneuver: Pull-Up/Push-Over
Actual AOA: 15°
Date: 03Jun94



Pilot Comments: [Pilot] ??? We got it pointing straight up. [Test Director] Roger that.
(snip to post-maneuver comments)
Comments on:

Initial Response at Control Input: [Pilot] Ok, initial response was very rapid. Control input was a full aft stick held for about a second and a half.

Initial Response at Control Reversal: [Pilot] Uh, ... Reversal, uh ... Went forward of neutral. We got the pitch attitude all the way up. ... Uh, ... I think I pretty much saw 85 degrees nose high on the HUD.

Max Rate: [Pilot] Max rate was quick. Not objectionable.

Reversal Overshoot Objection: [Pilot] Reversal overshoot objection? Uh, ... I don't know ... uh, as far as, uh, ... It was about what I expected, so I guess I didn't object to it. The nose was very high and ... by the time I got the stick forward, it, uh, it seemed to respond fairly quickly. About what I expected to see. [Test Director] Well, Jim, you're going to love this one. Uh, your one potato two was under 1 second, and we did not reach match max pitch rate before you pushed forward on the stick. So we've got a requested, uh ... repeat of this point. [Pilot] Ok.

Pitch Recovery Rating Scale: Not available.

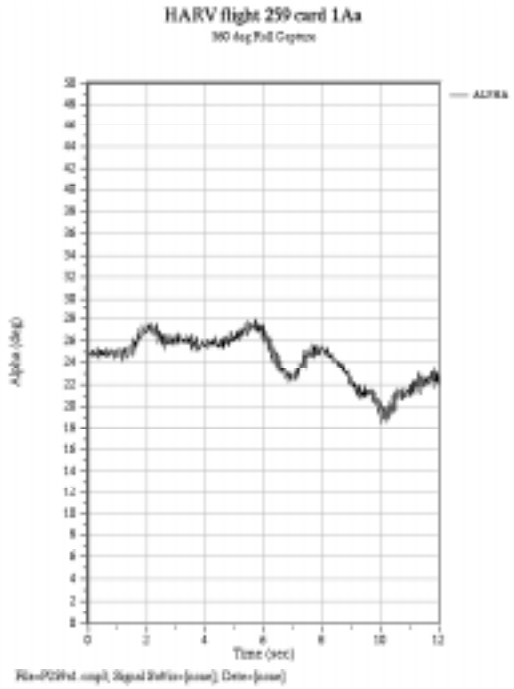
Other Comments: [Pilot] ... Ok, here we go ... ... I could have flopped it over my back that time. [Test Director] Ok, uh, we got maximum pitch rate on that one. Uh, any ... uh, any changes in the pilot comments from the previous ones. [Pilot] No. Uh ... the airplane was responsive, when I reversed the controls, and, uh, came back the way I wanted to. But, no. I was probably almost over on my back, uh, a little bit. [Test Director] Copy that. Well, that's the way it's supposed to work.

Times:

Maneuver Times: [begin-end]	14:07:26 - 14:07:40
Comment Times: [begin-end]	14:05:20 - 14:06:40 and 14:07:10 - 14:08:20

HARV HQ Comment Card

Flight: 259
Card #: 1Aa
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Initial Mach No: 0.34
Altitude: 25000
Desired AOA: 25°
Maneuver: 360° Roll Capture
Actual AOA: 19° - 27°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 07Jun94



Pilot Comments: [Pilot] ??? Finish. ... And max AB's coming. ... And rolling. End maneuver ??? [Test Director] And recover.
(snip to post-maneuver comments)
Comments on:
Roll Rate: [Pilot] Ok. Roll rate is, uh, very slow. Uh, ... I would say sl...
Bank Angle Capture: [Pilot] Uh. ??? and the bank angle capture was, uh, was right on. Uh, no problem with the bank angle capture due to the very, uh, slow roll rates. [Test Director] Ok. We'd like a Cooper-Harper for both your alpha control and the capture.
Alpha Control During Roll:
Cooper-Harper Rating: [Pilot] Ok. Uh. alpha control ... [???] Find the right scale here. Controllable? Yes. Adequate performance? Uh ... I would say Yes. Satisfactory without improvement? Uh ... No. Uh, minor but annoying deficiencies. I'd give it a 4 for alpha. Uh, bank angle. I would say, uh, it is ,uh, satisfactory. Give it a 2.
Longitudinal CHR: 4
Lateral/Dir CHR: 2
Other Comments:

Times:

Maneuver Times: [begin-end]	08:55:50 - 08:56:05
Comment Times: [begin-end]	08:56:05 - 08:57:45

HARV HQ Comment Card

Flight: 259
Card #: 3a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Initial Mach No: 0.22
Altitude: 27000
Desired AOA: 45°
Maneuver: 360° Roll Capture
Actual AOA: 43° - 49°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 07Jun94

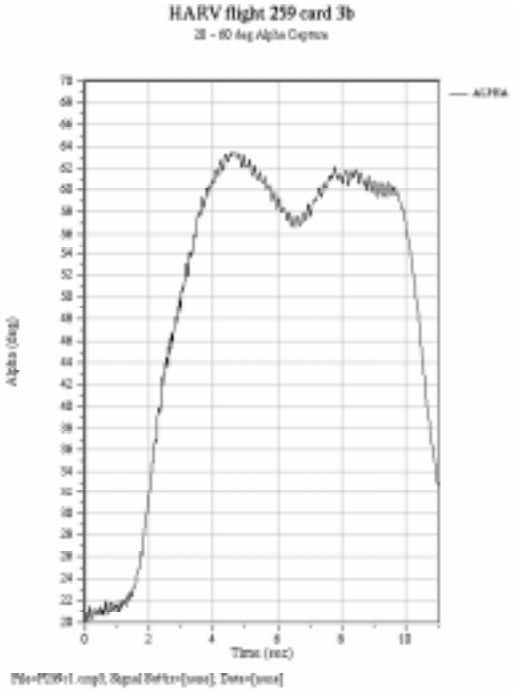
Pilot Comments: [Pilot] Ok, and ... here we go. ... Ok, recovered.
(snip to post-maneuver comments)
Comments on:
Alpha Control During Roll: [Pilot] Angle-of-attack control was good all the way around. Uh, till the very end, when I kinda slacked off to about 40 just before I, uh, recovered.
Roll Rate: [Pilot] The, uh, bank, uh ... roll rate was, uh, if you call it roll rate, was very slow. Uh, very controlled.
Bank Angle Capture: [Pilot] Uh, the bank angle capture ... Overshot ,uh, little bit, uh ... to about 15 degrees. Uh ... and was a little bit sluggish coming back the other way. [Test Director] Ok. Cooper-Harpers on both alpha control and ,uh, bank angle.
Cooper-Harper Rating: [Pilot] Ok. Controllable? Yes. Adequate performance? Uh, ... rating the roll .... I would say Yes. Satisfactory without improvement? Uh, ... I'm going to call it, uh, a Yes ... uh, ... sorta ignoring right at the end there. And, uh, ... I'll give it a 3. [Test Director] Copy 3. And that was for a bank angle control or alpha? [Pilot] Uh ... Bank angle capture. Controllable? Yes. Adequate? Uh, ... I would say Yes. Satisfactory? Uh, No. I'd give it a 4 with the, uh, problem being, uh, sluggishness, uh, to try to, uh, ... when you overshoot a little bit and you try to reverse it to capture ... uh, it's a little sluggish.
Longitudinal CHR: 3
Lateral/Dir CHR: 4
Other Comments:

Times:

Maneuver Times: [begin-end]	09:03:10 - 09:03:28
Comment Times: [begin-end]	09:03:28 - 09:05:20

HARV HQ Comment Card

Flight: 259
Card #: 3b
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Initial Mach No: 0.36
Altitude: 27000
Desired Capture AOA: 60°
Maneuver: 20°- 60° Alpha Capture
Actual Capture AOA: 60°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 07Jun94



Pilot Comments: [Pilot] Max power coming. And, you ready? [Test Director] We're ready. [Pilot] Here we go. ... [Test Director] Ok. Let's roll out.
(snip to post-maneuver comments)
[Pilot] The alpha capture, uh, ... I pulled the stick about, oh, I don't know, three quarters back. I didn't go to full aft stick. Uh ..., and it didn't look like it was going to make it all the way up there, uh, as it was going through about 50, so I pulled in a little bit more. Got it up to 63, then it slacked off to about 55 and then I had to pull it up to about 60, uh, uh, there ... for the right stick position [Test Director] Copy that.
Cooper-Harper Rating: [Pilot] for the, uh ... Let's go to the Cooper-Harper here. Controllable? Yes. Adequate performance? Uh, I would say Yes. Satisfactory without improvement? I would say, uh, a 4. Uh, we got a couple of overshoots, uh, you just sorta hunt for the stick position. That's all there is to it. You just ... you don't know what the stick position is that's going to give it to you, and you have to hunt for it.

Longitudinal CHR: 4
Confidence Rating: Not available.

Comments on:

Pitch Rate: [Test Director] Ok. We'd like comments on the initial pitch rate and, uh, overall time to capture. [Pilot] Uh, pitch rate was ... uh, the initial pitch rate was good. I didn't use every bit of it that was available. I could have probably done a more aggressive maneuver. [Test Director] Ok. [Pilot] But it was ... it was comfortable. It didn't look like there was going to be, uh, a big over control problem or anything like that. [Test Director] Uh, control lead objections?
Control Lead Objection: [Pilot] Uh, I guess I don't have any major objections there. Uh, it's not so much control lead as trying to figure out what position gives you, uh, what you're looking for.
Time to Capture:

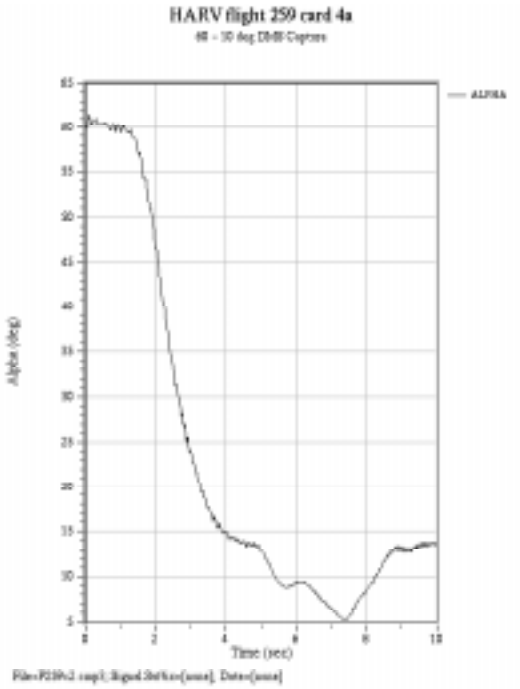
Pitch Recovery Rating Scale: Not available
Other Comments:

Times:

Maneuver Times: [begin-end]	09:07:13 - 09:07:23
Comment Times: [begin-end]	09:08:03 - 09:09:34

HARV HQ Comment Card

Flight: 259
Card #: 4a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Initial Mach No: Not available
Altitude: 27000
Desired Capture AOA: 10°
Maneuver: 60°-10° DMS Alpha Capture
Actual Capture AOA: 13°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 07Jun94



Pilot Comments: [Pilot] And ... here comes capture. ... And undershot it a little bit. [Test Director] Ok and stabilize level 250 knots, [Pilot Roger that.
(snip to post-maneuver comments)
[Pilot] Ok, for the DMS maneuvers, I, uh, ??? from 60 push the stick forward, uh, and just ??? to wag on to position, I wound up with about 15 degrees. And I had to push the stick a little bit further forward to capture 10 and it ... Once I figured out where the stick position actually was, it ... it settled right on 10. [Test Director] Copy that. Cooper-Harper for that.
Cooper-Harper Rating: [Pilot] Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Uh, I'd say Yes. The only ... I'd give it a 3. The only, uh, real deficiency is uh, trying to figure out where the stick position is to hold that particular angle of attack.

Longitudinal CHR: 3
Confidence Rating: Not available.

Comments on:

Pitch Rate: [Test Director] Ok, and comment on pitch rate and time, the effective time to capture 10. [Pilot] Pitch rate was smooth.
Time to Capture: [Pilot] Uh, the time was ... was, uh, I don't know. It seemed to be Ok. [Test Director] Need the control lead objections, also, for the, uh, pushover.
Control Lead Objection: [Pilot] I'd would give it the same comment. Uh, it's not so much, uh, a control lead in terms of trying to stop the maneuvers; it's trying to figure out where to put the stick in the first place. [Test Director] Ok, and, uh, also like comments on, uh, the uh, pitch rate and time to recovery, for the, uh, ... for the stabilization to 250. [Pilot] Yeah, there's plenty of pitch rate. The time. I have no comment on. Uh, It seemed to be ,uh, ... That's a performance issue and it seemed to be ... to be, uh, adequate.

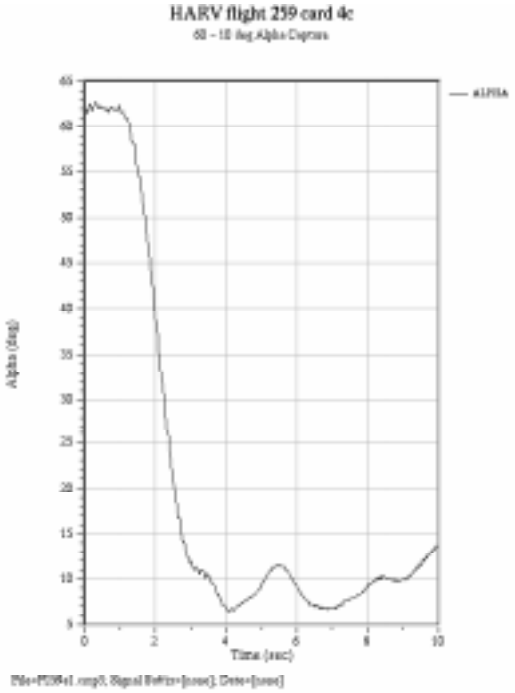
Pitch Recovery Rating Scale: Not available
Other Comments:

Times:

Maneuver Times: [begin-end]	09:07:37 - 09:08:02
Comment Times: [begin-end]	09:09:35 - 09:11:40

HARV HQ Comment Card

Flight: 259
Card #: 4c
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Initial Mach No: Not available
Altitude: 25000
Desired Capture AOA: 10°
Maneuver: 60°-10° Alpha Capture
Actual Capture AOA: 10°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 07Jun94



Pilot Comments: [Pilot] And here we go. ... [Test Director] ??? Recover. Looking good. Back on the charts.
(snip to post-maneuver comments)
Comments on:

Pitch Rate: [Pilot] Yeah. Pitch rate seemed to be, uh, good. Uh, the nose, uh, moves ... has a good nose down motion to it. No hesitations. Uh, trying to find the ... Once again, trying to hunt for the stick position that gets you 10 degrees and, uh, a little trouble finding it. Over shot ... to, well, I think I got to like 15 degrees, and then I pushed it, uh, a little more and then I overshot down to about 7 or 8 and then I had to fine tune it there. [Test Director] Ok. Control lead objections?

Control Lead Objection: [Pilot] Uh, don't really have any. [Test Director] Ok, and we'll take Cooper-Harper ratings on the, uh, on the 10, uh, capture.

Time to Capture:

Cooper-Harper Rating: [Pilot] Controllable? Yes. Adequate? Uh, I'd say Yes. Satisfactory without improvement? Uh, No. I'd give it a 4, uh, point 5. [Test Director] Copy 4.5. And, uh, dig out your pitch recovery rating scale. We'd like to run through that also. [Pilot] Aircraft is recoverable. Recovery was adequate. Recovery was highly desirable. I'd give it a , uh, 1 on that one.

Longitudinal CHR: 4.5

Confidence Rating: Not available.

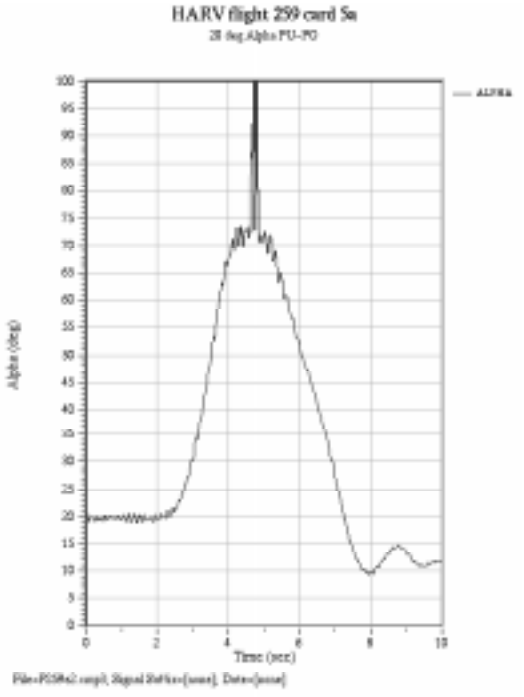
Pitch Recovery Rating Scale: 1
Other Comments:

Times:

Maneuver Times: [begin-end]	09:9:003 - 09:19:18
Comment Times: [begin-end]	09:19:18 - 09:20:51

HARV HQ Comment Card

Flight: 259
Card #: 5a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Initial Mach No: .36
Altitude: 27000
Desired Initial AOA: 20°
Maneuver: Pull-Up/Push-Over
Actual Initial AOA: 20°
Date: 07Jun94



Pilot Comments:
(snip to post-maneuver comments)
Comments on:

Initial Response at Control Reversal: [Pilot] Ok, uh, we're looking at the uh reversal. The, uh, ... control input was, uh, basically for forward stick. Uh, it took a little, uh, just a little bit of time for the airplane to respond to it, but it was, uh, comfortable. There was no doubt that it was going to ... uh , in other words, you expected it to overshoot to, uh, to up motion and it turned around fairly quickly, so I had confidence that it was going to recover.

Max Rate: [Pilot] Max rate was adequate**.**

Reversal Overshoot Objection: [Pilot] And, uh, the objection, uh, Reversal was about the size of overshoot that ... that one would expect with that pitch rate, uh ... [Test Director] Roger that. And what about your initial pitch rate, pitch up, uh, response on the, uh, control input?

Initial Response at Control Input: [Pilot] That was, uh, adequate in terms of the rate we got. About what I expected to see.

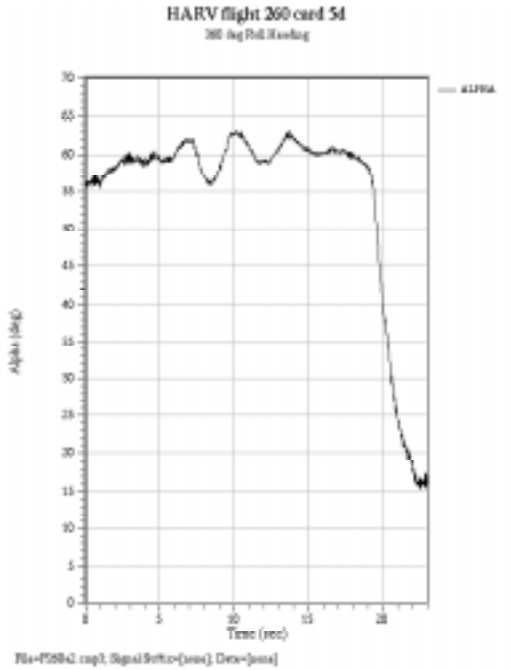
Pitch Recovery Rating Scale:
Other Comments:

Times:

Maneuver Times: [begin-end]	09:22:15 - 09:22:22
Comment Times: [begin-end]	09:22:22 - 09:23:40

HARV HQ Comment Card

Flight: 260
Card #: 5d
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/McMurtry
Mach No: Not available
Altitude: 18000
Desired AOA: 60°
Maneuver: 360° Roll (Heading) Capture
Actual AOA: 56° - 63°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 07Jun94



Pilot Comments: [Test Director] Heading capture. [Pilot] Ok, let me get the AOA. and here we go to left. ... Very slow to the left. ... Very slow ... and it's stopping ... and ... coming back to the right. [Test Director] And let's recover. Expect a download at 15 thousand.
(snip to post-maneuver comments)
[Pilot] Seems pretty clear that, uh, ... there's a fairly strong asymmetry in terms of the control power. [Test Director] Ok.

Comments on:

Heading Capture:

[Pilot] I'll give you the rate on the, uh, 360 heading, uh, ... Basically the airplane was controllable. Just couldn't do the task ... to the left at least. I have a feeling to the right that we'd probably get it cranked up pretty good. Might not be able to stop it, ... uh, once we get it cranked up. ... We can repeat it to the right, if you like.
[Test Director] We'll talk about it. Uh, why don't you go ahead and continue with your rating comments. [Pilot] It was the ... uh, ... yawing motion that was not, uh, that was not responding to input.

Cooper-Harper Rating:

So I'll give you the Cooper-Harper rating here. Ok, it was...uh, ... controllable? Yes. Adequate performance? Yes. Is it satisfactory performance? I would say Yes. I'd give it a 3. Uh, ... for the heading capture, however, uh, the maneuver was not doable. Therefore, I would say improvement is mandatory. I'd give it a 10. [Test Director] Ok the above.

Longitudinal CHR: 3
Lateral/Dir CHR: 10

Comments on:

Roll Rate: [Test Director] And, uh, comment on the initial roll rate. [Pilot] Well, it wasn't so much roll rate. Yaw rate was very slow, and it only yawed off about 45 degrees and then it sorta wanted to reverse and go the opposite direction, even though I had full ... uh, ... full lateral stick in.

Alpha Control During Roll:

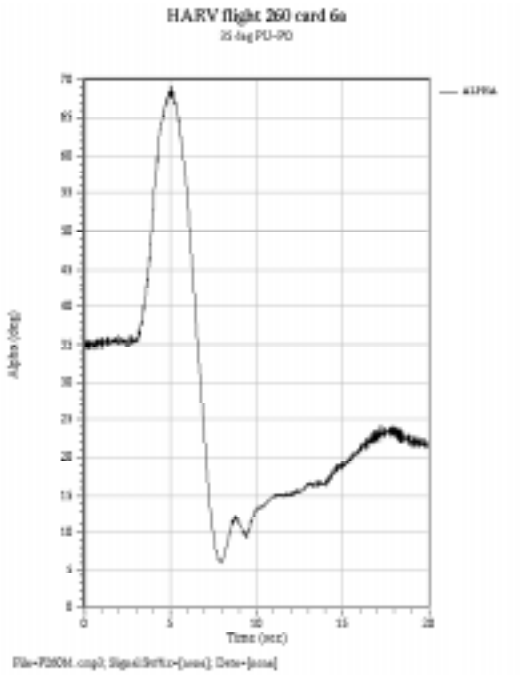
Other Comments:

Times:

Maneuver Times: [begin-end]	11:24:30 - 11:24:53
Comment Times: [begin-end]	11:24:53 - 11:26:54

HARV HQ Comment Card

Flight: 260
Card #: 6a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/McMurtry
Mach No: 0.28
Altitude: 27000
Desired Initial AOA: 35°
Maneuver: Pull-Up/Push-Over
Actual Initial AOA: 35°
Date: 07Jun94



Pilot Comments: [Pilot] Ok. ... And here we go. .... [Test Director] Ok, Sir. Looked like a good ... uh, maneuver from down here. We'll take your comments.
(snip to post-maneuver comments)
Comments on:

Initial Response at Control Input: [Pilot] Ok, the initial response to the aft stick was a little bit on the sluggish side. Uh ... I would give it a ... uh, between a, uh, moderate to slow, uh, response.

Initial Response at Control Reversal: [Pilot] Uh, as far as reversal goes, the airplane ... uh, ... went full forward stick. Uh, the reversal was, uh, not quite instantaneous, but it, uh, recovered very quickly ... to a nose down, uh, motion.

Max Rate: [Pilot] The max rates, uh, ... in terms of pitch rates encountered, ... uh, like I said, uh, in the up position ... were slow to moderate. And, uh, in the down direction were adequate.

Reversal Overshoot Objection: [Pilot] And, uh, there was not a large overshoot once the stick was pushed forward. So I don't have any objection there.

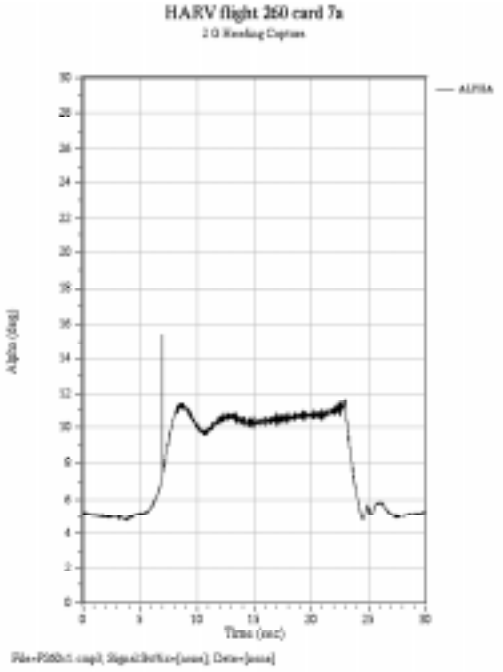
Pitch Recovery Rating Scale: Not available.
Other Comments:

Times:

Maneuver Times: [begin-end]	11:31:40 - 11:31:55
Comment Times: [begin-end]	11:31:55 - 11:32:57

HARV HQ Comment Card

Flight: 260
Card #: 7a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/McMurtry
Mach No: 0.61
Altitude: 27000
Desired G's: 2.0
Maneuver: 2G/Heading Capture
Actual G's: 2.0 - 2.2
Desired: G +/- .2°
Heading +/- 2°
Adequate: G +/- .3°
Heading +/- 6°
Date: 07Jun94



Pilot Comments: [Pilot] Here we go. [Test Director] And we're ready down here. ... [Pilot] A little overshoot in G's. ... Ok, captured.
(snip to post-maneuver comments)
[Test Director] Ok. Good maneuver. We'll take your comments.
Comments on:

G Capture/Hold: [Pilot] Ok. Uh, the G capture ... There's a slight tendency for the airplane to want to, uh, increase in G's. It turns out, the, uh, the little G meter up here ... uh, the iron gauge's got enough parallax in it, it's kinda hard to even read 2 G's up here. I kinda cross-checked with the HUD a little bit. The, uh ... Once we got it on the G's though, uh, I was able to stay there, uh, quite nicely.

Heading Capture: [Pilot] I overshot the, uh, heading by about the angle of attack; and then as soon as I relaxed the stick, or relaxed the G's on the airplane, and, uh, and rolled wings level, it came out to within about 2 degrees of the desired heading I was looking for. So, uh ...

Cooper-Harper Rating: [Test Director] Ok, the emphasis on the, uh, Cooper-Harper on the G part of it is the hold part of it as you're going around the turn as opposed to the capture. [Pilot] Roger that. I'd say it's controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes. I will give it a, uh, a 2 for the hold. And, uh, the capture, I'll give it a 3. [Test Director] That was on the G-capture a three? [Pilot] Yes. [Test Director] Ok. [Pilot] Heading capture, I'd give it a, uh, I'd give it a, uh, 2. [Test Director] Copy that.

Longitudinal CHR: Hold - 2; capture - 3

Lateral/Dir CHR: 2

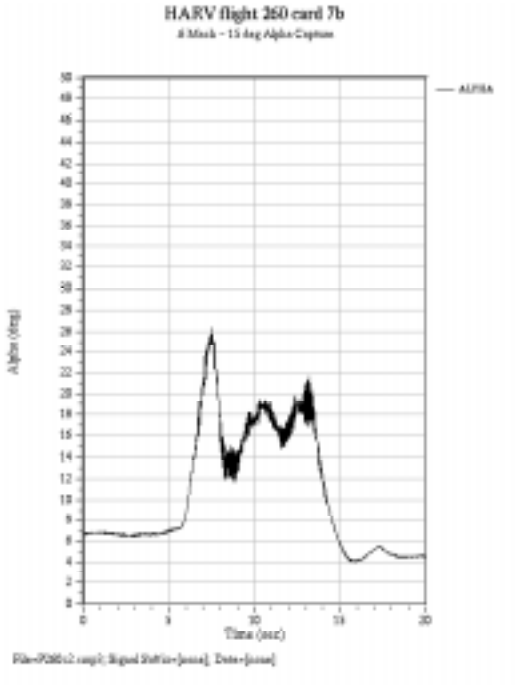
Other Comments: [Test Director] And comments on the difficulties with the overall task, and, uh, what part of the task is a, uh, flight test evaluation tool. [Pilot] I think it's pretty low gains. You know, I think there's some merit to, uh, taking a look at ... at getting G's and how ... how much, uh, overshoot you might encounter, if you just, uh, went ... for a specific G. Cause there's some indication there of, uh, of, uh, what could happen in a combat scenario, I suppose; but it's pretty low, low gain task overall and the many capture part, I'm not sure as to why ....

Times:

Maneuver Times: [begin-end]	11:34:34 - 11:35:00
Comment Times: [begin-end]	11:35:00 - 11:37:16

HARV HQ Comment Card

Flight: 260
Card #: 7b
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/McMurtry
Altitude: 25500
Desired Initial Mach: 0.6
Maneuver: .6M - 15° Alpha Capture
Actual Initial Mach: 0.6
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 07Jun94



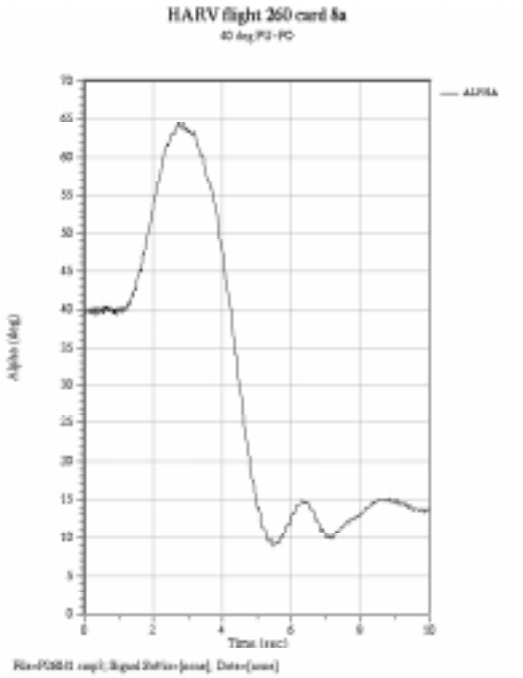
Pilot Comments: [Pilot] Here come the burners. And ... Capturing ... ...
(snip to post-maneuver comments)
Ok the initial, uh, response was more abrupt than what I expected. And, uh, I think as it started to dig in around 15, uh, it felt like the airplane was digging in; and so, uh, I overshot to about, uh, 17 or 18 and then backed off to 10 and then zeroed in on 15. So I think the aircraft's sensitivity, uh, might have showed itself a little bit there. [Test Director] Copy that.
Cooper-Harper Rating: [Test Director] Uh, alpha capture ... Cooper-Harper. [Pilot] ??? Roger that. [Test Director] It's, uh, +/- 4 for desired; +/- 7 for adequate. [Pilot] ??? Satisfactory without improvement??? No. I would say, uh, a 5. Moderately objectionable, uh, because of the tendency for the airplane to dig in. [Test Director] Copy that.
Longitudinal CHR: 5
Confidence Rating: Not available.
Pitch Recovery Rating Scale: Not available.
Comments on:
Control Lead Objection: [Test Director] And comments on control lead objections. [Pilot] Uh, again, I really don't have any comments there. Uh, once again, it's difficult to figure out exactly where the stick needs to be, to be exactly the angle of attack you want it to be.
Pitch Rate: Not available.
Time to Capture:
Other Comments:

Times:

Maneuver Times: [begin-end]	11:38:30 - 11:38:43
Comment Times: [begin-end]	11:38:43 - 11:40:33

HARV HQ Comment Card

Flight: 260
Card #: 8a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/McMurtry
Mach No: 0.25
Altitude: 27000
Desired Initial AOA: 40°
Maneuver: Pull-Up/Push-Over
Actual Initial AOA: 40°
Date: 07Jun94



Pilot Comments: [Pilot] I got a bias in, a little bit of, uh, left stick here. [Test Director] Roger that. Clear to maneuver. [Pilot] OK. And ... here we go.
(snip to post-maneuver comments)
[Test Director] Ok. Good maneuver from down here. Let's go tank one inhibit, while you give us your comments.
Comments on:

Initial Response at Control Input: [Pilot] Ok, uh, the initial response in the up direction was, uh, what I would call somewhat sluggish.

Initial Response at Control Reversal: Uh, about the time I got to the end of the 2 seconds, uh, the 2 potatoes, I mean; it was ready to reverse. Uh, the pitch rate had pretty much died out ... so that as soon as I went full forward stick, the airplane responded nose down. Uh, with very little hesitation, if any.

Max Rate: The max rate for the nose down was, uh, was adequate. Uh, not exceptionally fast, but it was certainly adequate.

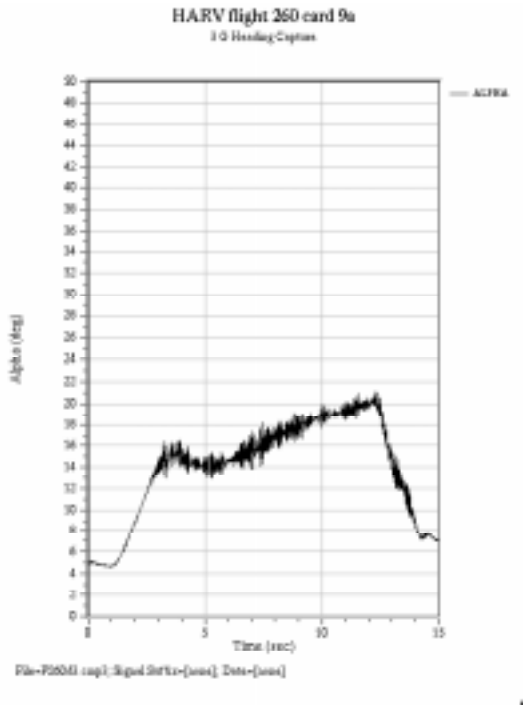
Reversal Overshoot Objection: And, uh, reversal overshoot objection? There wasn't much of an over ... overshoot in the first place; so it was, uh, fairly benign.
Pitch Recovery Rating Scale: Not available.
Other Comments:

Times:

Maneuver Times: [begin-end]	11:43:00 - 11:43:15
Comment Times: [begin-end]	11:43:15 - 11:44:17

HARV HQ Comment Card

Flight: 260
Card #: 9a2
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/McMurtry
Mach No: 0.6
Altitude: 27000
Desired G's: 3.0
Maneuver: 3G/Heading Capture
Actual G's: 2.65 - 2.85
Desired: G +/- .2°
Heading +/- 2°
Adequate: G +/- .3°
Heading +/- 6°
Date: 07Jun94



Pilot Comments:
(snip to post-maneuver comments)
Comments on:

Heading Capture: [Pilot] Ok. Captured the alpha about 5 degrees of overshoot there. I mean, the, uh, heading. That's a, uh, ... the gamesmanship part of the maneuver ... is how much you have to overshoot before you roll out. According to ??? task,

G Capture/Hold: [Pilot] I didn't watch the G's real close; there's too much else to watch. But it felt like I stayed pretty much on the G's that I was aiming for. What's your opinion on that? [Test Director] OK. Checking the charts. Yes, you stayed, uh, relatively on to what you were looking for. And the mach number was ... within the limits there, too. So, it was a good maneuver. You can go ahead and rate it and comment.

Cooper-Harper Rating:

[Pilot] Ok ... Comment the G's here. G capture and hold first. [Test Director] Stay wings level. [Pilot] Is it controllable? Yes. Uh, adequate? I would say Yes. Satisfactory without improvement? Uh, Yes. I'd give the overall G maneuver a 2. Did not see the, uh, the tendency to sensitivity I saw with the 2 G maneuver as you, uh, get out of conditions. The, uh, heading capture, uh, ... What's the criteria here? [Test Director] Uh, +/- 2; +/-6. [Pilot] We're in the adequate because of gamesmanship, uh, that you have to play. Uh, I would still say that, uh, it ... I would say ... Satisfactory without improvement? Well, we're in the adequate criteria, so that forces us into a No. Although, that's not what I believe. I'd give it a 4, because of the, uh, the, uh, the 4 degrees or so of heading error. My personal opinion it's not an aircraft, uh, handling-qualities deficiency. What it is, is a task deficiency.

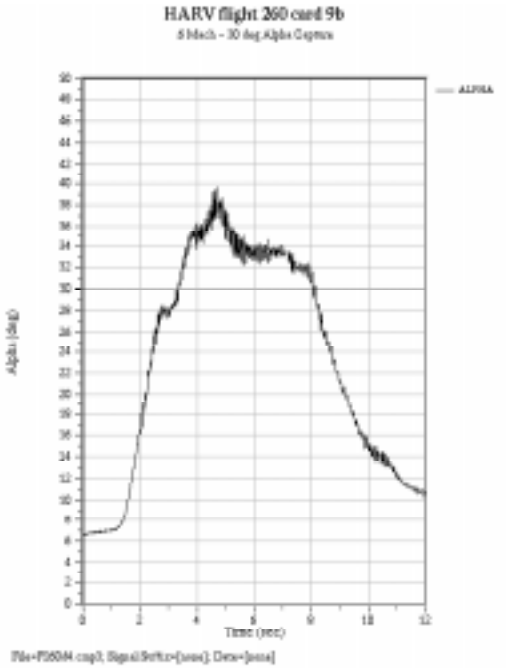
Longitudinal CHR: 2
Lateral/Dir CHR: 4
Other Comments:

Times:

Maneuver Times: [begin-end]	11:47:20 - 11:47:35
Comment Times: [begin-end]	11:47:35 - 11:49:35

HARV HQ Comment Card

Flight: 260
Card #: 9b
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/McMurtry
Altitude: 26000
Desired Initial Mach: 0.6
Maneuver: .6M - 30° Alpha Capture
Actual Initial Mach: 0.615
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 07Jun94



Pilot Comments: [Pilot] I have enough control power there. Uh, got up to about 3.8 in the cockpit. There is a sensation that the airplane's really digging in; which is, uh, probably because it is. The, uh, so I, I kinda slacked off the AOA in my initial onset rate .... about the time, I felt that dig in; and I brought it right up to 30 and I stopped it right at 30. I think as you maybe got used to the airplane, there would be maybe less hesitancy there.

Comments on:

Pitch Rate: : [Pilot] Pitch rate was, uh, was good.

Time to Capture: : [Pilot] Time to capture? I thought it was a fairly aggressive maneuver. I don't have any qualms about aggressiveness ... uh, with RG restrictions on the airplane. Although, I could be ... I could've gone a little bit a little bit harder on it.

Cooper-Harper Rating: [Pilot] Is it controllable? Yes. Adequate performance? Uh, Yes, I would say. Satisfactory without improvement? I would say, uh, I'm going to give it a 4.5 on that. Uh, the primary reason is the, uh, the G dig-in tendency that I feel ... uh, is somewhat disconcerting.

Longitudinal CHR: 4.5

Confidence Rating: : Not available

Pitch Recovery Rating Scale: Not available

Comments on:

Control Lead Objection: : [Pilot] Control lead objections. Uh ... Once I ... that I just happened to hit the 30 degree stick position pretty well, so I wasn't really much of an overshoot and it pretty well stayed right at 30, when it got there.

(snip to post-maneuver comments)

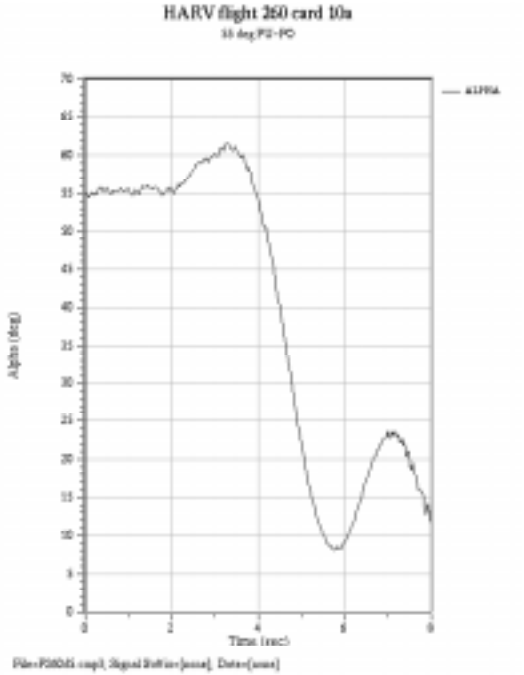
Other Comments:

Times:

Maneuver Times: [begin-end]	11:50:30 - 11:50:50
Comment Times: [begin-end]	11:50:50 - 11:52:33

HARV HQ Comment Card

Flight: 260
Card #: 10a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/McMurtry
Mach No: Not available
Altitude: 27000
Desired Initial AOA: 55°
Maneuver: Pull-Up/Push-Over
Actual Initial AOA: 55°
Date: 07Jun94



Pilot Comments: [Pilot] And I'm ready, if you are. [Test Director] Let's go for it. [Pilot] Ohh!... There's a nice little, uh, reversal. [Test Director] Roger that. I knew we'd get one for Keith eventually.
(snip to post-maneuver comments)
Comments on:

Initial Response at Control Input: [Pilot] OK, The initial response. The airplane was very sluggish ... in the up-direction.

Initial Response at Control Reversal: [Pilot] In the reversal, uh, the airplane basically was out of poop anyway; so, uh, it was just a matter of aiding the nose coming down. It wasn't going to go up any more. Uh, and the reversal pitch rate was pretty good.

Max Rate: [Pilot] Max rate going up was slow. Max rate going down was, uh, was certainly adequate.

Reversal Overshoot Objection: [Pilot] ... No reversal overshoot objection. It, uh, was similar to the previous maneuver in that it, uh, wasn't going to go any higher anyways.

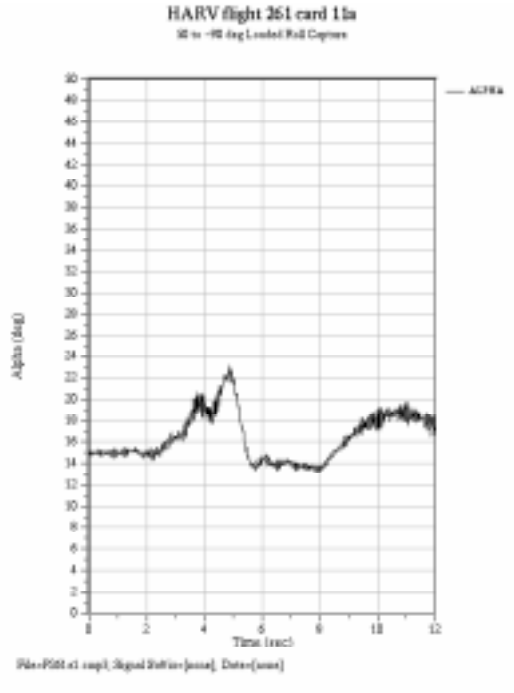
Pitch Recovery Rating Scale: Not available.
Other Comments: [Pilot] And that's ... I guess we don't have ??? ratings. [Test Director] Like to have you comment on the sensitivity at the end. Were you in the loop? Etc. Just comment on that, please. [Pilot] All I did was, uh, pitch over until the nose was below the horizon, and then I just basically tried to stop a little bit. And the angle of attack, uh, kinda rebounded after it hit it's minimum value ... uh, in the opposite direction again and, uh, got into a little bit of pitch sensitivity.

Times:

Maneuver Times: [begin-end]	11:54:51 - 11:56:00
Comment Times: [begin-end]	11:56:00 - 11:56:03

HARV HQ Comment Card

Flight: 261
Card #: 11a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Fullerton
Mach No: .39
Altitude: 25000
Desired AOA: 15°
Maneuver: 50° to -90°
Loaded Roll
Capture
Actual AOA: 13° - 23°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 07Jun94



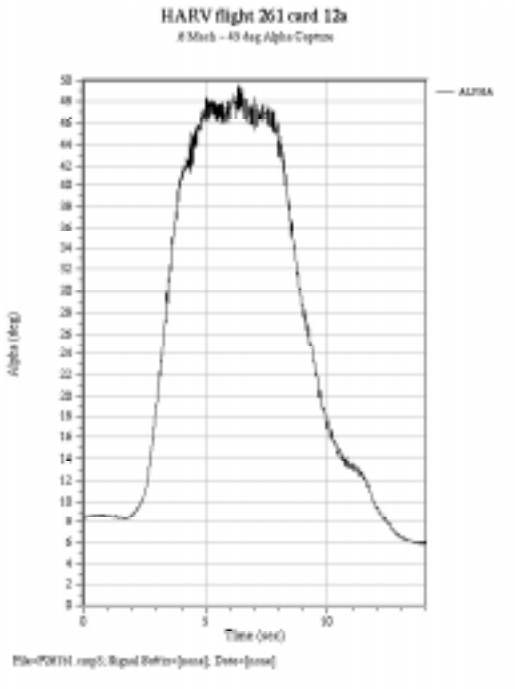
Pilot Comments:
(snip to post-maneuver comments)
Comments on:
Alpha Control During Roll: [Pilot] Ok. Alpha control during the roll was ... uh, ... was good except right at the end, when I tried to stop the roll, uh, we got the alpha up a little bit ... about 20 degrees.
Roll Rate: : [Pilot] Roll rate was uh, fast.
Bank Angle Capture: : [Pilot] ??? bank angle capture. Probably undershot just a little bit, uh, I think we were in the 10 degree, uh, criteria though. [Test Director] OK. We'll take Cooper-Harpers on both alpha and bank angle capture.
Cooper-Harper Rating: [Pilot] Ok. Uh, alpha controllable? Yes. Adequate? Uh, ... I'd say a Yes. Satisfactory without improvement? Uh, ... I'd say Yes. I'd give it a 3. Uh, bank angle capture, uh, ... I will give that a 3 also. A slight, uh, ... When I tried to stop it, or so, I got a little ... just a little bit of a ... a burble there. Cause it's 90 degrees, it's kinda strange.
Longitudinal CHR: 3
Lateral/Dir CHR: 3
Other Comments:

Times:

Maneuver Times: [begin-end]	14:15:12 - 14:15:22
Comment Times: [begin-end]	14:15:22 - 14:16:25

HARV HQ Comment Card

Flight: 261
Card #: 12a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Fullerton
Mach No: .58
Altitude: 25000
Desired Capture AOA: 45°
Maneuver: 0.6M - 45° Alpha Capture
Actual Capture AOA: 47°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 07Jun94



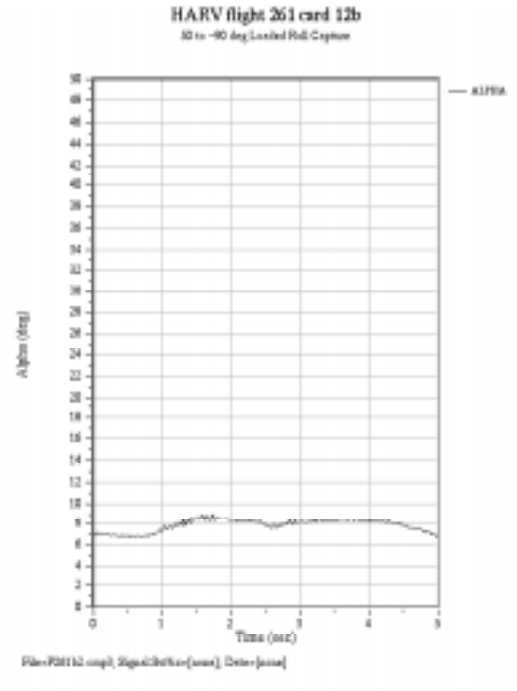
Pilot Comments:
(snip to post-maneuver comments)
Comments on:
Pitch Rate:
[Pilot] OK. Pitch rate, uh, we ended up with about 4 G ... 4.1 G's on the, uh, cockpit gauge here. ... The, uh, ... pitch rate was ... was good. I did not notice, uh, the big G, uh, dig-in as much as I've noticed in the past. Uh, ... I brought it right back, uh, fairly aggressively ... and I just happened to hit real close to 45 degrees ... uh, amazingly. And it went right to 45 degrees. There was a lot of shaking going on. It was difficult to read the gauge ... but, uh, looked to me like we hit it right on. So, I'll give you a Cooper-Harper here. [Test Director] OK.
Cooper-Harper Rating: [Pilot] Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Uh, yeah, I think so. I would give it a 2.
Longitudinal CHR: 2
Comments on:
Control Lead Objection: [Test Director] Copy above. And any control lead objections? [Pilot] I didn't have, uh, any overshoot or, uh, anything ... so, uh, I just pulled the stick right back and it ... I magically hit 45 ... so, uh, I think it was luck as much as anything.
Time to Capture: Not available
Other Comments:

Times:

Maneuver Times: [begin-end]	14:18:31 - 14:18:41
Comment Times: [begin-end]	14:18:41 - 14:20:05

HARV HQ Comment Card

Flight: 261
Card #: 12b
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Fullerton
Mach No: .6
Altitude: 25000
Desired AOA: 5°
Maneuver: 50° to -90°
Loaded Roll
Capture
Actual AOA: 7° - 8.5°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 07Jun94



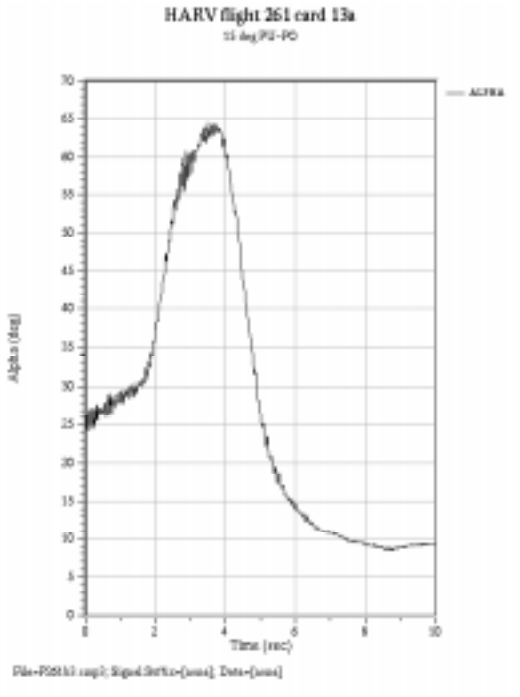
Pilot Comments:
(snip to post-maneuver comments)
Comments on:
Alpha Control During Roll: [Pilot] OK, when I rolled the, uh, angle of attack increased to, uh, about 9. I'm not sure whether I put a little bit of aft stick in or not.
Roll Rate: [Pilot] Roll was very quick.
Bank Angle Capture: Bank angle, uh, stopped pretty much, uh. right when I asked it to. I'd say I was within 10 degrees.
Cooper-Harper Rating: [Pilot] OK, controllable? Yes. Adequate? ... This is for alpha. ... Adequate performance? Let's see. ... What was the criteria? 6 degrees. So we got adequate. Satisfactory without improvement? I'd say, uh, No. Uh, we did exceed the 2 degrees. I would give it a 4. Well, I didn't get desired, so I really can't give it a 4. How about if I give it a, uh, 4.5? I don't think, uh, ... the angle-of-attack control is critical for this particular maneuver. Uh, ... and I don't think you can really control it anyways. If you start to see it go, and it's almost too fas... , the roll rate is too fast ... ; by the time you're at your bank angle, you don't have time to make your correction. [Test Director] Roger that. [Pilot] OK, for the bank angle. Uh, controllable? Yes. Adequate? Yes. Satisfactory? I'd say, Yes. I'd give it a 2.
Longitudinal CHR: 4.5
Lateral/Dir CHR: 2
Other Comments:

Times:

Maneuver Times: [begin-end]	14:21:20 - 14:21:28
Comment Times: [begin-end]	14:21:28 - 14:22:50

HARV HQ Comment Card

Flight: 261
Card #: 13a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Fullerton
Mach No: 0.6
Altitude: 27000
Desired Initial AOA: 15°
Maneuver: Pull-Up/Push-Over
Actual Initial AOA: 28°
Date: 07Jun94



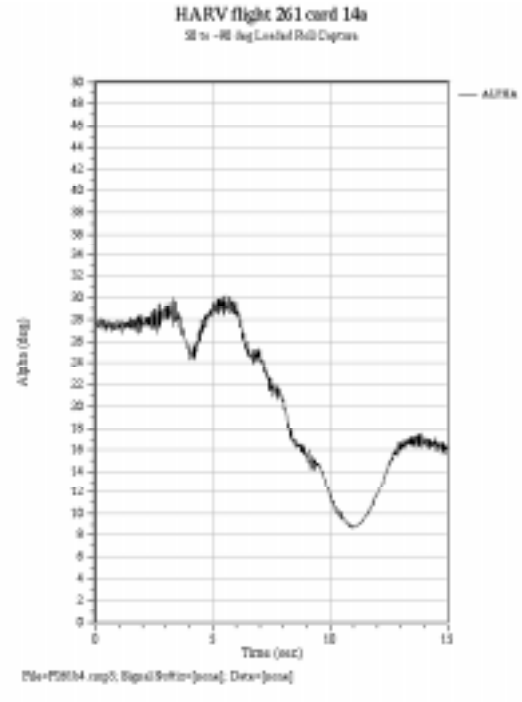
Pilot Comments:
(snip to post-maneuver comments)
[Pilot] Turned out about , uh, 20 degrees alpha, but we were at point 6. I hit the mach number good, so, uh, ...
Comments on:
Initial Response at Control Input: [Pilot] Control input was, uh, full aft stick for the 2 potatoes there. ... Uh, the initial response was, uh, quick.
Initial Response at Control Reversal: [Pilot] Reversal, uh, was also, uh, quick. We're in a bank angle. Uh ... You don't get these super high, uh, pitch attitudes. A little bit hard to tell what the nose is doing, but, uh, ... it definitely stopped, uh ... digging in, and, uh, and reversed the opposite direction.
Reversal Overshoot Objection: [Pilot] Uh, the reversal overshoot? Uh, really none.
Max Rate: [Pilot] The max rates, uh, were ... moderate ... to fast.
Other Comments:

Times:

Maneuver Times: [begin-end]	14:25:19 - 14:25:29
Comment Times: [begin-end]	14:25:29 - 14:26:34

HARV HQ Comment Card

Flight: 261
Card #: 14a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Fullerton
Mach No: .42
Altitude: 25000
Desired AOA: 25°
Maneuver: 50° to -90°
Loaded Roll
Capture
Actual AOA: 9° - 27°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 07Jun94



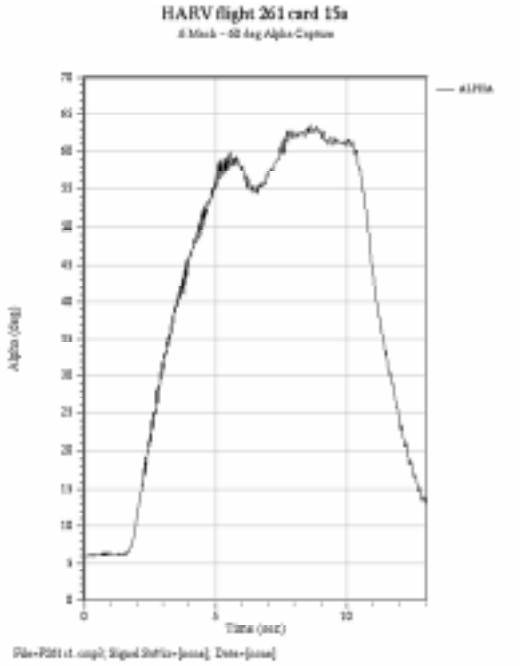
Pilot Comments:
(snip to post-maneuver comments)
Comments on:
Alpha Control During Roll: [Pilot] OK. Angle-of-attack control was, uh, good**.** I did have time to make some, uh, corrections.
Roll Rate: [Pilot] The roll rate is, uh, I would call moderate to slow. So there was time to make a, uh ... The angle of attack initially wanted to increase and I did ... was able to, uh, correct that, hold it pretty much on conditions all the way through the maneuver ... until we started the bank-angle capture.
Bank Angle Capture: [Pilot] The bank-angle capture was within 10 degrees. A little tendency to be a little sloppy there, uh, trying to check the roll rate.
Cooper-Harper Rating: [Pilot] Controllable? Yes. Uh, this is for the, uh, alpha. Adequate? Yes. Satisfactory? I'd say, Yes. Uh, I'll give it a 3. Minimal pilot compensation. And, uh, the bank angle capture, I will also give a 3 due to the little bit of sloppiness that, uh, occurs.
Longitudinal CHR: 3
Lateral/Dir CHR: 3
Other Comments:

Times:

Maneuver Times: [begin-end]	14:28:12 - 14:28:20
Comment Times: [begin-end]	14:28:20 - 14:29:26

HARV HQ Comment Card

Flight: 261
Card #: 15a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 851/Fullerton
Mach No: .59
Altitude: 25000
Desired Capture AOA: 60°
Maneuver: 0.6M - 60° Alpha Capture
Actual Capture AOA: 61°
Desired: AOA +/- 4°
Adequate: AOA +/- 7°
Date: 07Jun94



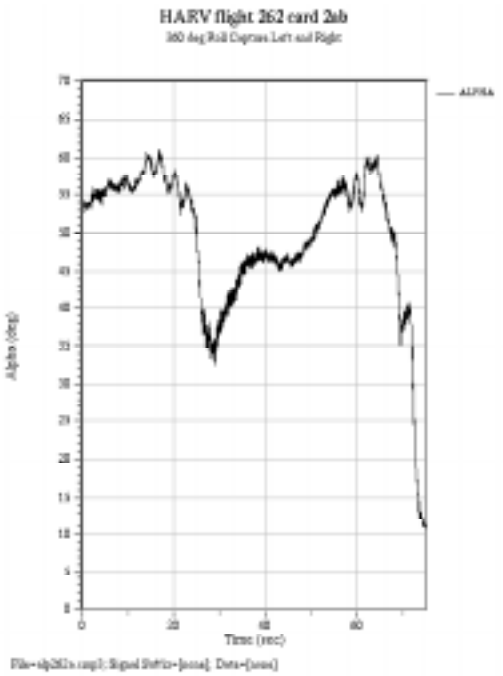
Pilot Comments:
(snip to post-maneuver comments)
[Pilot] OK. We got about 4.4 G's on that one. Let's see. Uh, I got the alpha. It took a little bit of fine tuning, uh, as it went up as I could kinda see where it was looking like it might settle down, and I increased the stick forces as required to, uh, to pull it up. I got it up to about 62. Then it undershot back down to 55. And then I settled it right down on 60, uh, without too much of a problem.
Comments on:
Pitch Rate: [Pilot] Uh, pitch rate is, uh, quick. Uh, that time to capture, uh, ... I think that was a pretty aggressive maneuver.
Time to Capture: [Pilot] Uh, the time to capture was, uh, was probably about, uh, as good as it can get without, uh, getting closer to the G limits on the airplane. So, I think it was adequate. We, uh, did get, uh, the AOA within 4 degrees initially. It dropped off to about -5. So I guess ... with that big of a change in the angle of attack, uh (interference???) ... I ... give it ... a rating for ... adequate ??? ???
Cooper-Harper Rating: [Pilot] OK. I'd give it a 4. Uh, uh, going up the tree there, I'd give it a 4. The only reason is and I don't really ... I'm not hard over on the 4 ... ... ??? we did not get within the, uh, desired criteria. [Test Director] Roger that. And any control lead objections, uh, pulling up on the alpha?
Longitudinal CHR: 4
Comments on:
Control Lead Objection: [Pilot] No. I really, uh ... It's more control lag than lead. Uh, the ... uh, the tendency is to pull and see what you're going to get and then pull a little bit more ... uh, ... from my experience at least. I did not go full aft stick during the maneuvers.
Other Comments:

Times:

Maneuver Times: [begin-end]	14:30:45 - 14:30:60
Comment Times: [begin-end]	14:30:60 - 14:32:50

HARV HQ Comment Card

Flight: 262
Card #: 2ab
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Mach No: Not available
Altitude: 27000
Desired AOA: 55°
Maneuver: 360° Roll Capture
Left and Right
Actual AOA: 35° - 60°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 09Jun94



Pilot Comments: [Pilot] ??? five ??? [Test Director] We're ready. [Pilot] Right ??? here goes to the left. Alpha wants to build ... and it's ... pretty slow. ... OK? [Test Director] OK. That looked, uh, ... good. That was your capture. Head it on up to 55 and do it the other way. [Pilot] Roger that. Ok, and here we go. Little bit higher yaw rate ... [Test Director] And recover.
(snip to post-maneuver comments)
Comments on:

Alpha Control During Roll: [Pilot] OK, here's the comments. Uh, the left maneuver ... uh, angle of attack, uh ... control ... was, uh, fairly easy within about 4 to 5 degrees. Uh, at one point it got up as high as 60, and I thought I could recognize that the yaw rate might have been slowing down as the angle of attack increased. Most of the time I was able to keep it around 55. Just a few bobbles outside of that region.

Bank Angle Capture: [Pilot] Uh, as you capture, the airplane ... (outside interference obliterates pilot comments) opposite the yaw rate .... (more outside interference obliterates pilot comments) before it starts to come back. Uh, it did overshoot a little bit, uh, on the heading. Actually, I think the first one I pretty much put the heading right on. Uh, I, uh, I was able to slow it down. Uh, the second one I did overshoot about 20 degrees, and then, uh, it came right back.

Roll Rate: [Pilot] Uh, the yaw rate to the right was faster than the yaw rate to the left. The left one was very slow. ... I'd say the right one was, uh, was moderate for that type of maneuver.

Cooper-Harper Rating: [Pilot] Cooper-Harper. Controllable? Uh, this is for the left maneuver alpha and bank angle. Alpha first. Controllable? Yes. Adequate, uh performance? Uh, I would say we got adequate performance. Satisfactory without improvement? No. I'd give it a, uh, 5. For the, uh, bank angle capture ... uh, Adequate? [Test Director] 840-NASA-1. Uh, what we'd like to do is have you, uh, uh, give us the Cooper-Harper rating on alpha for both the left and right comments, and that'll be good for now. [Pilot] OK. Uh, I gave it a 5 for the alpha control. Uh, during the, uh, maneuver to the left ... uh, the alpha ... uh, I was on it pretty well; and it dropped off to about 53, 52 and then came up to about 60 at one point. I did notice that the yaw rate dropped off as the angle of attack increased. Just a perception. It wasn't a, uh, whole lot. Uh, and then I got it back down to 55. Uh, the yaw rate, uh, for the left maneuver was, uh, slow. The yaw rate for the right maneuver was, uh, moderate. Uh, it was a little faster to the right than to the left. And Cooper-Harpers for the bank angle capture, I gave a 4, uh, for the two of them, uh, I pretty much captured right on, uh, the first maneuver to the left cause of the slower yaw rate. Uh, the one to the left, I overshot about 20 degrees. [Test Director] Copy that and confirm that, uh, that, uh, your, uh, Cooper-Harper for alpha capture was 5 for both of them? [Pilot] Uh, that's affirm. [Test Director] OK.

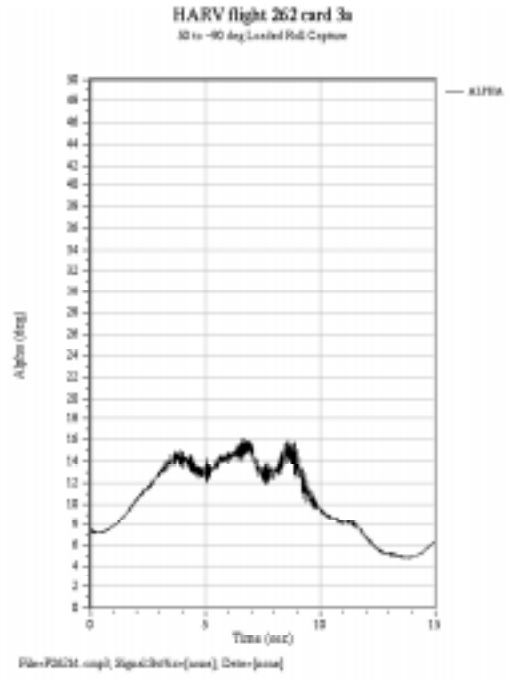
Longitudinal CHR: 5
Lateral/Dir CHR: 4
Other Comments:

Times:

Maneuver Times: [begin-end]	09:00:30 - 09:01:35
Comment Times: [begin-end]	09:01:35 - 09:05:27

HARV HQ Comment Card

Flight: 262
Card #: 3a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Mach No: 0.6
Altitude: 25000
Desired AOA: 15°
Maneuver: 50° to -90°
Loaded Roll
Capture
Actual AOA: 10° - 15°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 09Jun94



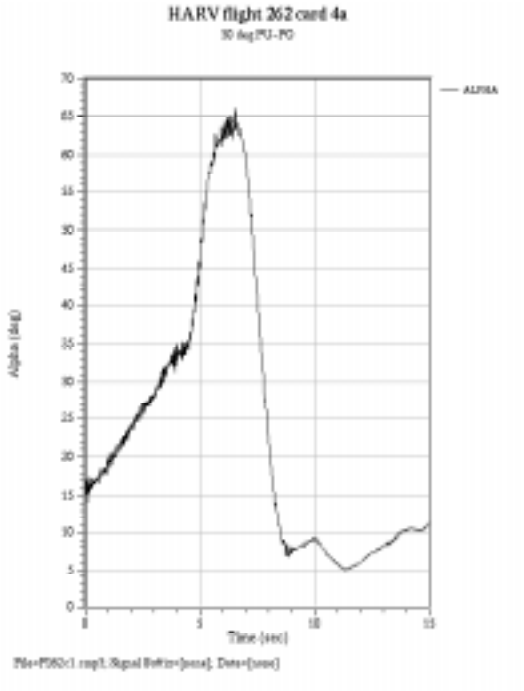
Pilot Comments:
Comments on:
Roll Rate: [Pilot] Uh, ... Roll rate was, uh, moderate.
Alpha Control During Roll: [Pilot] Alpha control, uh, looked pretty good within about a degree or so, uh, maybe 2 degrees.
Bank Angle Capture: [Pilot] Bank angle capture was, uh, no problem. Uh, easily within, uh, +/ 10.
(snip to post-maneuver comments)
Cooper-Harper Rating: [Pilot] Give us some Cooper-Harpers here. [Test Director] OK. [Pilot] Ok, the alpha control is ... controllable? Yes. Adequate? Uh, Yes. Satisfactory without improvement? I'd give it a Yes. I'd give it a 3. Don't really have time to ma... to make much of a correction. [Test Director] Copy that. [Pilot] And as far as the, uh, bank angle capture, I'll give it a 2.
Longitudinal CHR: 3
Lateral/Dir CHR: 2
Other Comments:

Times:

Maneuver Times: [begin-end]	09:09:10 - 09:09:31
Comment Times: [begin-end]	09:09:31 - 09:10:32

HARV HQ Comment Card

Flight: 262
Card #: 4a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Mach No: 0.53
Altitude: 27000
Desired Initial AOA: 30°
Maneuver: Pull-Up/Push-Over
Actual Initial AOA: 34°
Date: 09Jun94



Pilot Comments:
(snip to post-maneuver comments)
Comments on:

Initial Response at Control Input: [Pilot] OK. Initial response, I'd say was moderate, uh, pitch rate.

Initial Response at Control Reversal: [Pilot] Uh, the reversal, uh, ... The airplane was very responsive. Uh, came down pretty much as soon as, uh, relaxed the, uh, aft stick and pushed it to the front stop.

Max Rate: [Pilot] Max rate was, uh, like I say, moderate, not uncomfortable. Got about 3-1/2 G's in the cockpit.

Reversal Overshoot Objection: [Pilot] And, uh, no objections to the, uh, reversal. Airplane responded pretty much to the way I expected it to.

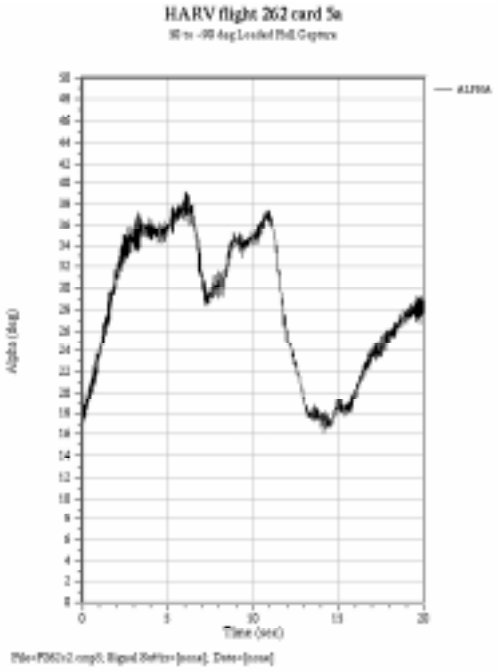
Other Comments:

Times:

Maneuver Times: [begin-end]	09:13:06 - 09:13:14
Comment Times: [begin-end]	09:13:14 - 09:14:05

HARV HQ Comment Card

Flight: 262
Card #: 5a
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Mach No: 0.4
Altitude: 25000
Desired AOA: 35°
Maneuver: 50° to -90°
Loaded Roll
Capture
Actual AOA: 18° - 37°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 09Jun94



Pilot Comments:
(snip to post-maneuver comments)
Comments on:

Alpha Control During Roll: [Pilot] Not sure I did very well. I wanted the alpha to drop off to about ... to about 30 there. And then pulled it back up.

Bank Angle Capture and Roll Rate: [Pilot] The, uh, yaw rate was very slow. The airplane's a little sluggish trying to stop the roll rate once you get it going. I overshot about 20 degrees, uh, the bank angle. OK. Let's see. I give ... Uh, alpha control there ... Let me look at it. I think I could probably do a little better job on alpha control if, uh, I did it again. I will give that maneuver, however, a, uh, ... I'd give it a 4. And bank angle capture, I think because of the, uh, sluggish, uh, response in roll ... Going to give it a 5. [Test Director] Question for you, uh, Jim. The sluggishness comment? Was that on, uh, the starting of the roll, the stopping of it, or through it? Uh, can you expound on it? [Pilot] Uh, the sluggishness was pri ... primarily, uh, the stopping. Uh, the roll rate is relatively slow. The, uh, but the airplane overshoots quite a bit when you reverse controls. And, uh, so you're just along for the ride there until the airplane starts to respond again. So it, uh, ... Took the controls out just a little bit late and we overshot to about 20 degrees, which means it's hard to do a nice crisp, uh, man ... maneuver.

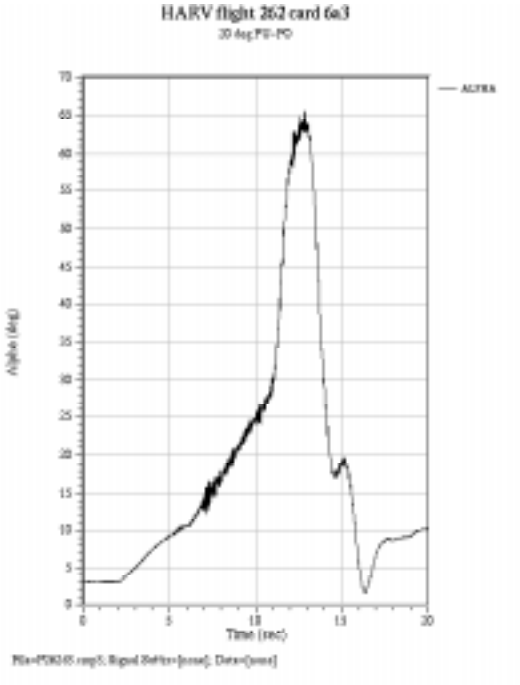
Cooper-Harper Rating:
Longitudinal CHR: 4
Lateral/Dir CHR: 5
Other Comments:

Times:

Maneuver Times: [begin-end]	09:15:30 - 09:15:45
Comment Times: [begin-end]	09:15:45 - 09:17:47

HARV HQ Comment Card

Flight: 262
Card #: 6a3
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Mach No: 0.67
Altitude: 27000
Desired Initial AOA: 20°
Maneuver: Pull-Up/Push-Over
Actual Initial AOA: 28°
Date: 09Jun94



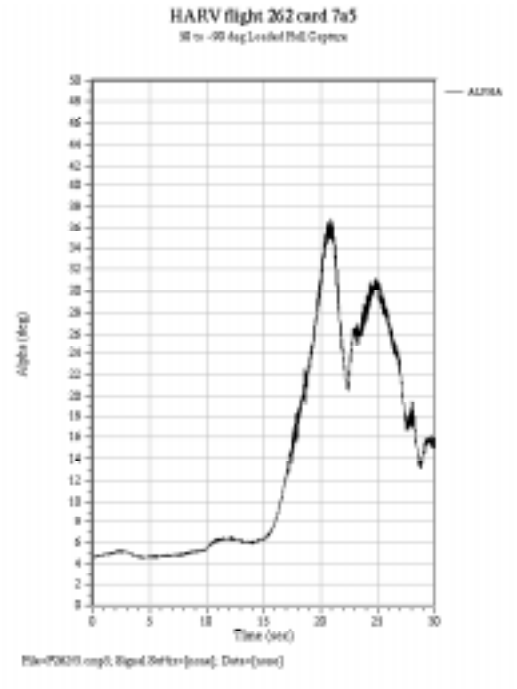
Pilot Comments:
(snip to post-maneuver comments)
[Pilot] OK. I think we hit the parameters on that one. [Test Director] Uh. Looked like right on the money to us down here. Uh, we'll take your comments.
Comments on:
Initial Response at Control Input: [Pilot] Ok. Initial response, uh, was uh, uh ... quite responsive. Uh, good pitch rate.
Initial Response at Control Reversal: [Pilot] Reversal, uh, pretty much as soon as I put the stick forward. The airplane's very responsive, and it, uh, stopped, uh, uh, as soon as the stick hit the forward stop and came back down.
Max Rate: [Pilot] Max rate was certainly adequate.
Reversal Overshoot Objection: [Pilot] And no ... uh, over ... overshoot objections.
Other Comments:

Times:

Maneuver Times: [begin-end]	09:21:00 - 09:21:15
Comment Times: [begin-end]	09:21:15 - 09:21:52

HARV HQ Comment Card

Flight: 262
Card #: 7a5
CLAW: V101.1
Pilot: Smolka
Chase A/C: 843/Ishmael
Mach No: .59
Altitude: 27000
Desired AOA: 20°
Maneuver: 50° to -90°
Loaded Roll
Capture
Actual AOA: 26° - 36°
Desired: AOA +/- 2°
Bank angle +/- 10°
Adequate: AOA +/- 6°
Bank angle +/- 20°
Date: 09Jun94



Pilot Comments:
(snip to post-maneuver comments)
Comments on:

Alpha Control During Roll: [Pilot] OK. Alpha control. Because of the acquisition task, it overshot to 30. You can't really get it stabilized, before you start to maneuver. Otherwise, the mach number's too low. [Test Director] Roger that. [Pilot] And, uh, I don't know exactly what mach number we started at, but I think, uh, the needle was below the, uh, index. So, uh, we were somewhere below .6 but above .55 . [Test Director] Roger that. I, uh, observed that here. [Pilot] Uh, during the roll, uh, the, uh, alpha dropped off to about 20 as I tried to reacquire 25. And then about halfway through the roll, I got 25 and held it there until the, uh, bank-angle capture.

Bank Angle Capture: [Pilot] The bank angle, uh, ... was, uh, just a little bit sluggish, uh, during the, uh, ... trying to stop the roll but, uh, ... uh, not unexpected.

Roll Rate: [Pilot] I would say the roll rate was a ... was a moderate roll rate.

Cooper-Harper Rating: [Pilot] The alpha control during the maneuver a, uh, going up the table here, I'd give it a, uh, 5. Uh, ... Part of that is just the, uh, the initial, uh, acquisition of the alpha. You gotta get right with it and that causes an overshoot up about 5 degrees or so and then you have to correct from there. The, uh, bank angle capture, uh, was within the, uh, ... I think was ... was within the desired criteria. Uh, I will give that a, uh, ... I'll give it a, uh, a 3.

Longitudinal CHR: 5
Lateral/Dir CHR: 3
Other Comments:

Times:

Maneuver Times: [begin-end]	09:29:10 - 09:29:22
Comment Times: [begin-end]	09:29:22 - 09:31:05

Concluding Remarks

Pilot comments and ratings for selected handling-qualities maneuvers from HARV flight tests of the NASA-1A Control Law were transcribed for use by controls engineers in evaluating control law performance, handling-qualities design criteria, and flight test maneuvers. A total of 36 files were transcribed for maneuvers from Flights 256, 257, 258, 259, 260, 261, and 262. These transcriptions were entered on Pilot Comment Forms with other pertinent maneuver information, and the completed Pilot Comment Forms are included in this report. Audio files for Flight 319 were also transcribed. However, these were for the ANSER control law, and the transcriptions are not included in this report.

The digitized audio files provided by DFRC for Flights 256 through 262 are stored on the LaRC DCB Sun computer system in directory */grissom16/wtb/Comments*. Within *Comments* the directory *au260-262*, for example, contains digitized audio files for Flights 260-262.

Appendix A
Handling-Qualities Maneuvers

Contents

Notation

α - angle-of-attack

A/B - after burner

A/C- aircraft

alt - altitude

N_z, n_z - normal acceleration

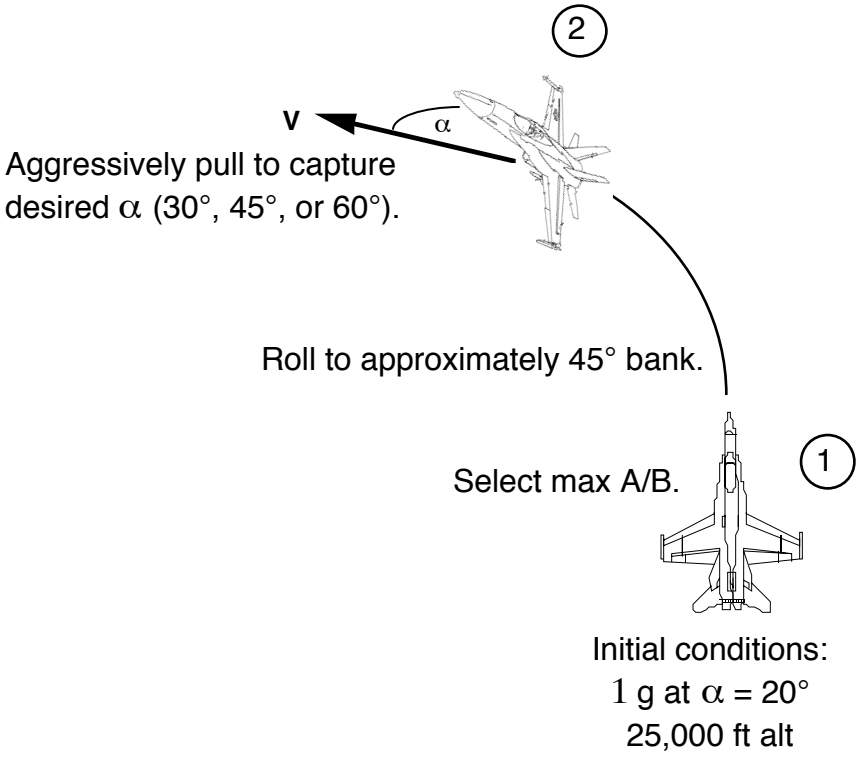


Figure A1.- Alpha-capture from $\alpha = 20°$.

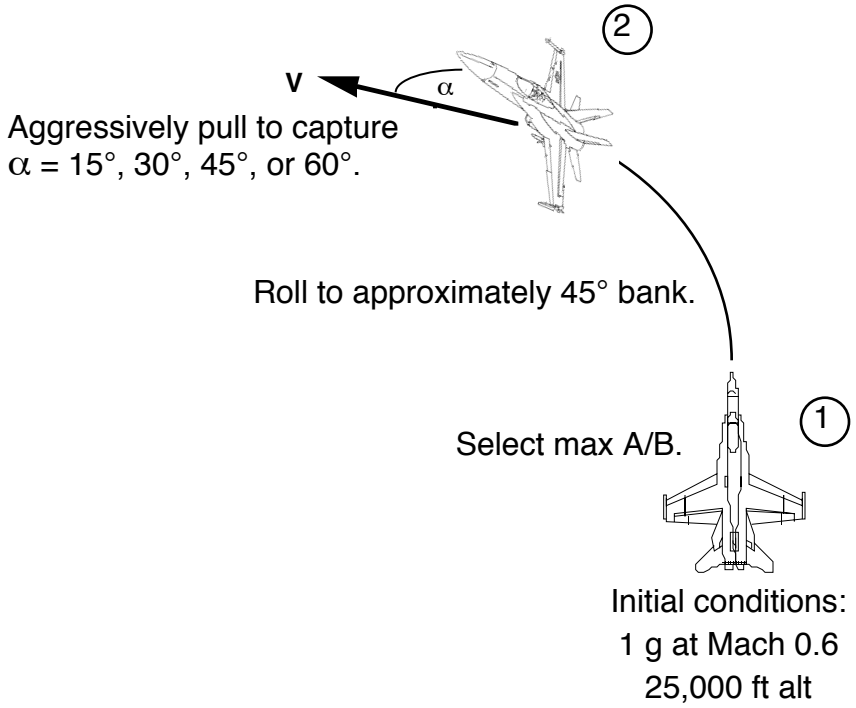


Figure A2.- Alpha-capture from Mach 0.6.

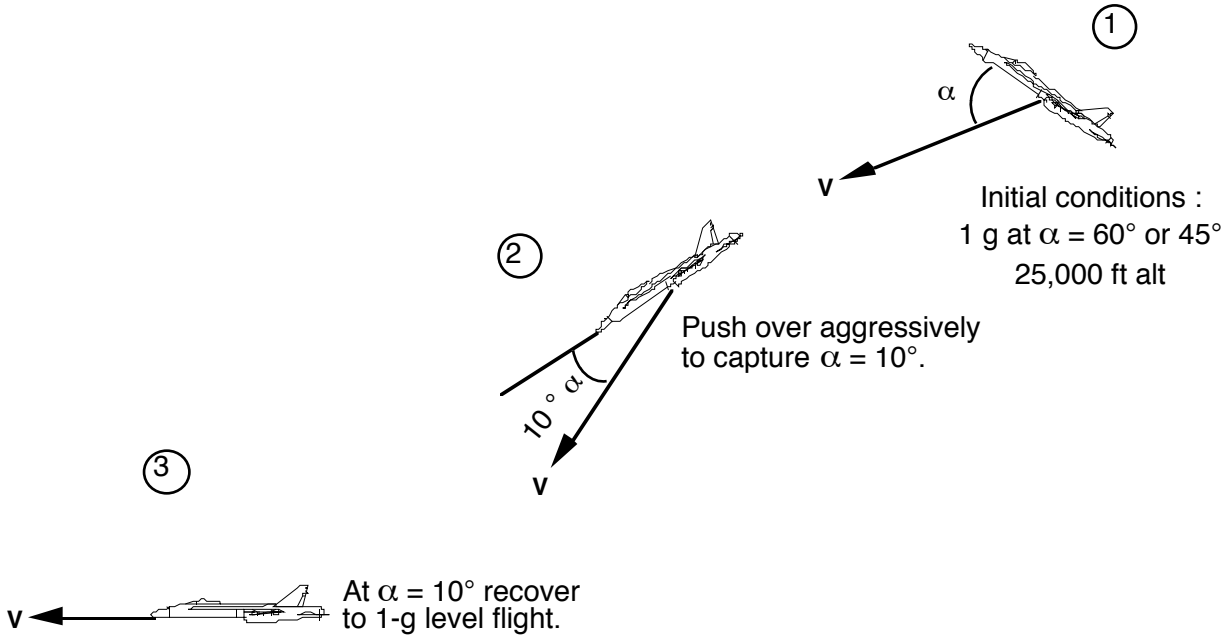


Figure A3.- Alpha-capture from $\alpha = 60°$.

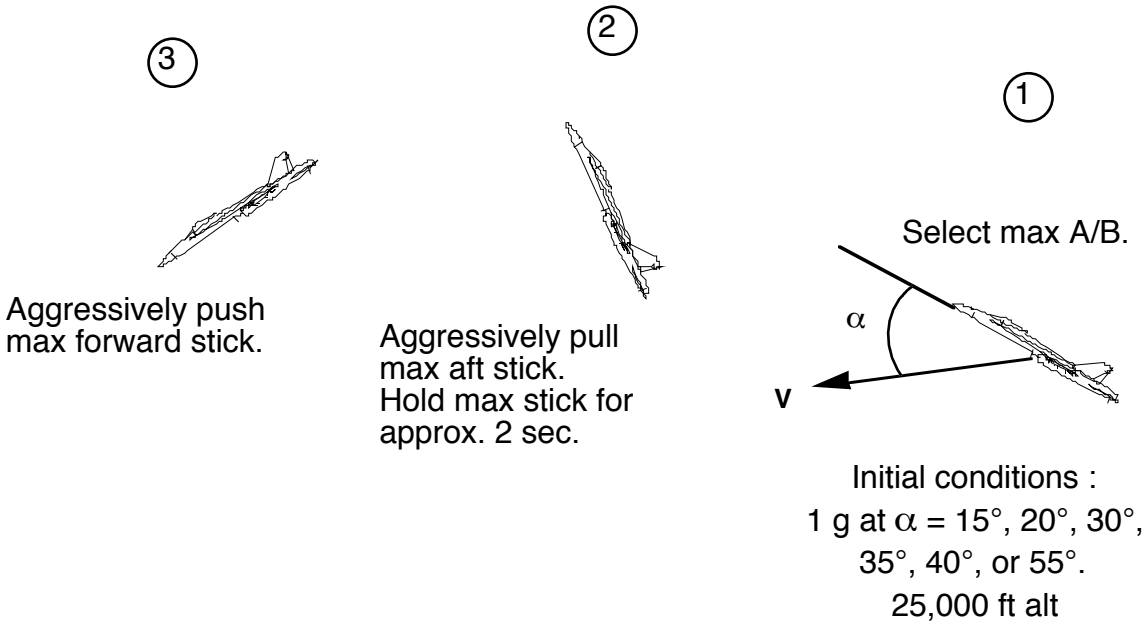


Figure A4.- Pull-up/push-over.

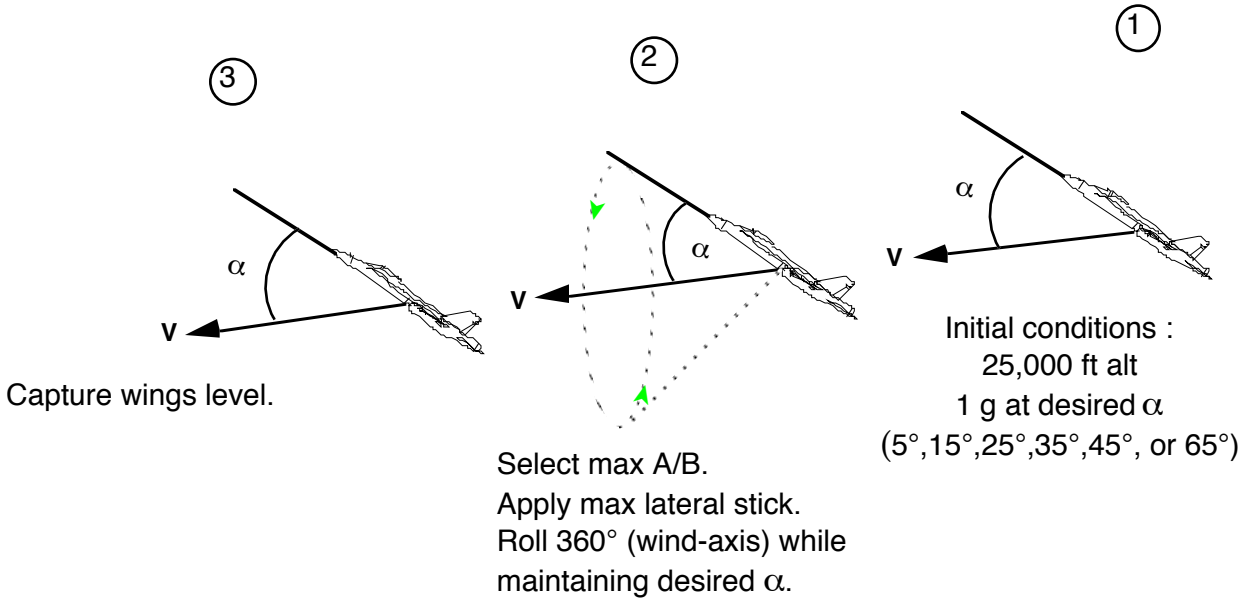


Figure A5.- 360° Roll/heading-capture.

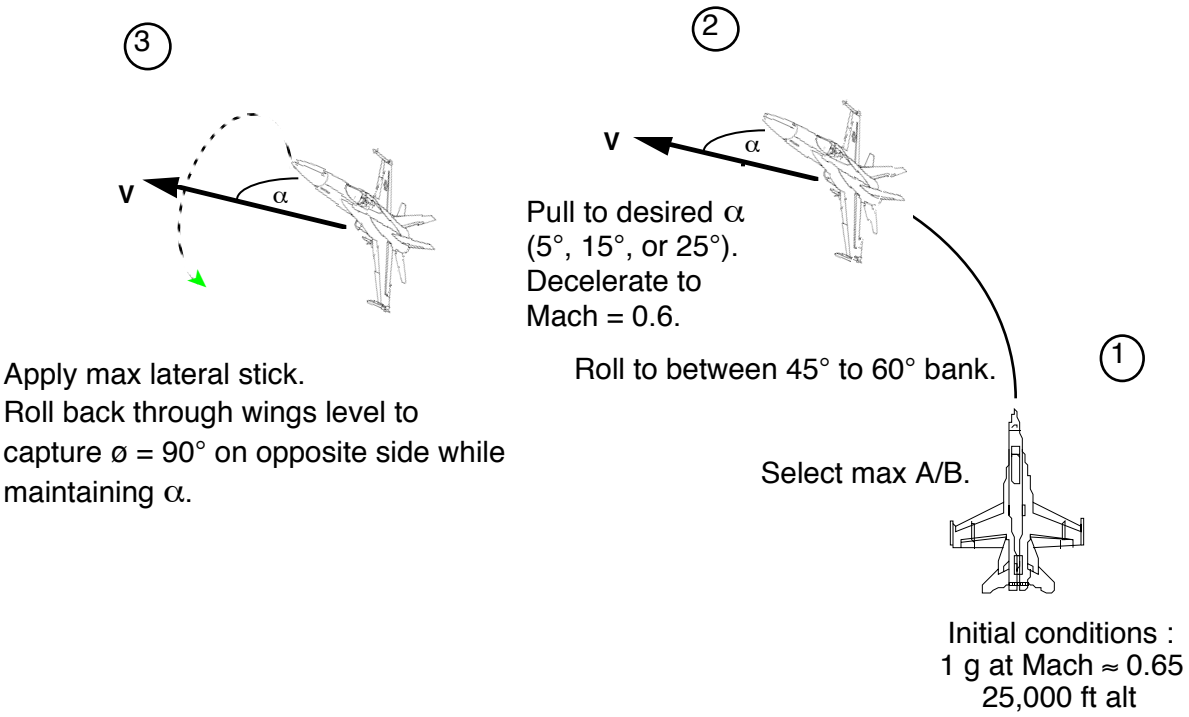


Figure A6.- Loaded-Roll capture.

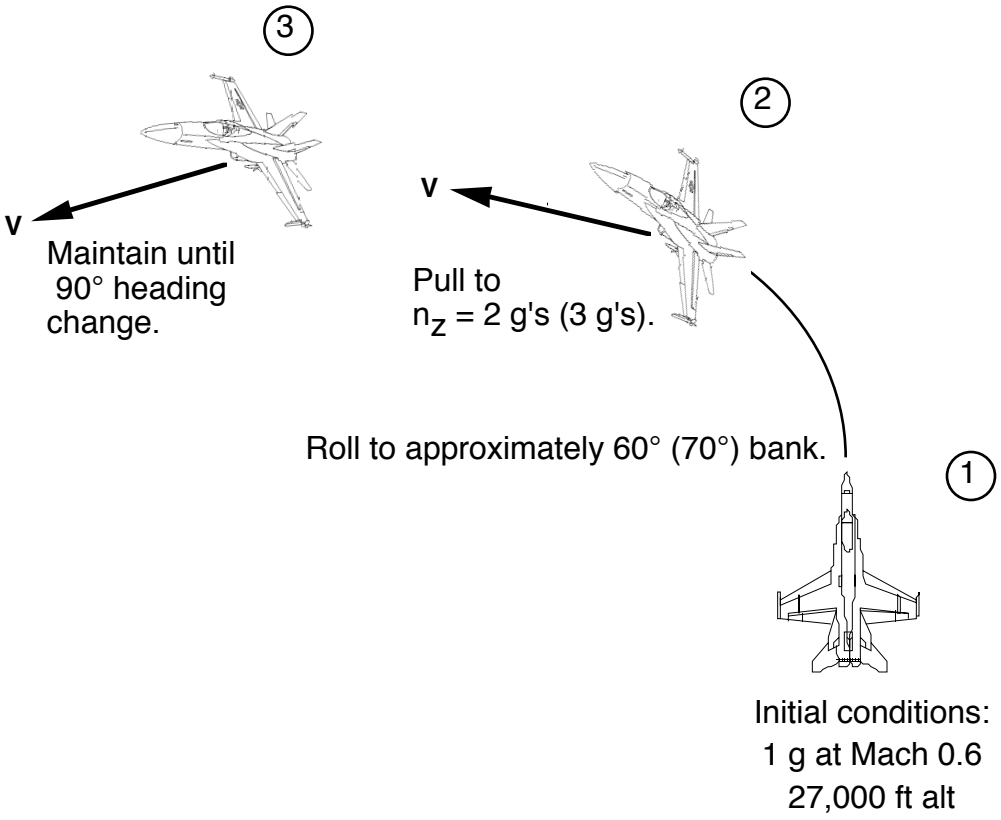


Figure A7.- N_z(g)/heading-capture.

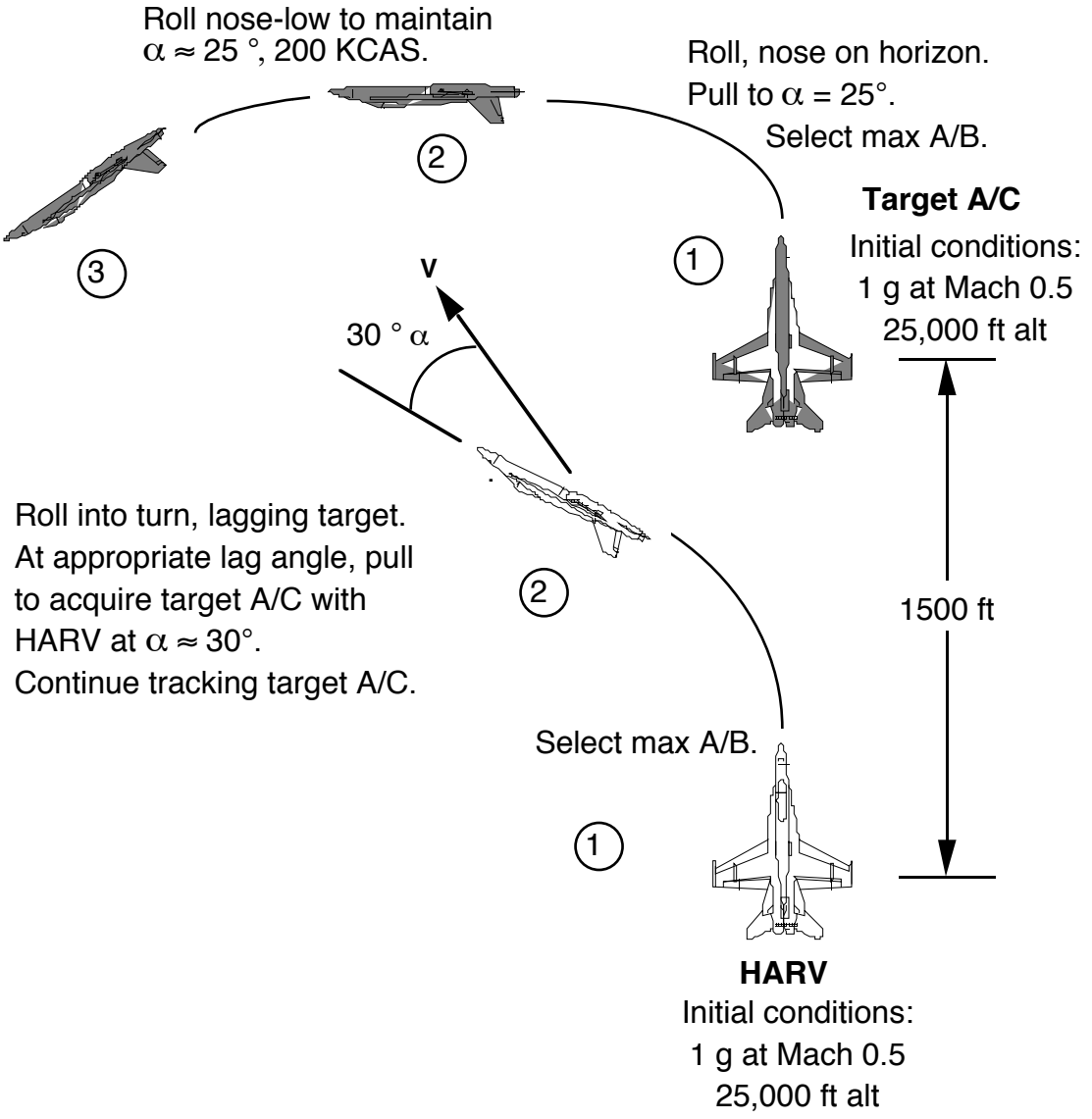


Figure A8.- 30 °-α longitudinal/lateral tracking.

Appendix B
Handling-Qualities Sample Flight Card

F-18/840 PRINT DATE: 26-jul-1994

FTE DATABASE SYSTEM CARD VERSION: Flight

F-18 S/N 840	DATE: 03-JUN-94	FLIGHT: 256-258	Fuel_____ Time_____ GW/CG_____

TEST: CONT LAW EVAL

30 Deg Alpha RFCS: ON
25000 Hi FLAPS: UP/AUTO
0.50 Mi

Limits: NO PIO;12.5 MILS 50 PCT,25 MILS REM; 10 PCT, 25 MILSDisc: Sim Notes:

12.5 MIL RET; 80 MIL DEP

A LONGITUDINAL AND LATERAL TRACKING - MAX A/B POWER HQ /CONT

HARV : 1500 FT BEHIND; TAR: .5M, 25 AOA, 200 KTS

WITH TARGET; 1 INCH LONG & LAT DOUBLETS AT END.

PILOT COMMENTS:

ATTITUDE CONTROL:
UNDESIRABLE MOTIONS_____

PREDICTABILITY_____

INITIAL RESPONSE_____

DIFFICULTY WITH GROSS ACQUISITION_____

AGGRESSIVENESS EFFECTS H/Q?_____

COMPENSATION TECHNIQUES_____

ROLL PERFORMANCE_____

RPC = _____

FEEL SYSTEM:

FORCES_____

CONTROL MOTION_____

HARMONY_____

NONLINIERITY_____

COOPER/HARPER LONG/LAT HQR =_____

(NEXT PT: _____) 008

PLANNING DATABASE CARD NO = 3774
TRUE CONDITIONS : 0.50 MT / 200 KCAS / 25000 FT / 30 DEG ALPHA
CARD COMMENTS: GROSS ACUQISION AND TRACKING

Figure B1.- Flight Card for Flight 258 card 008.

Appendix C
Pilot Rating Scales

Contents

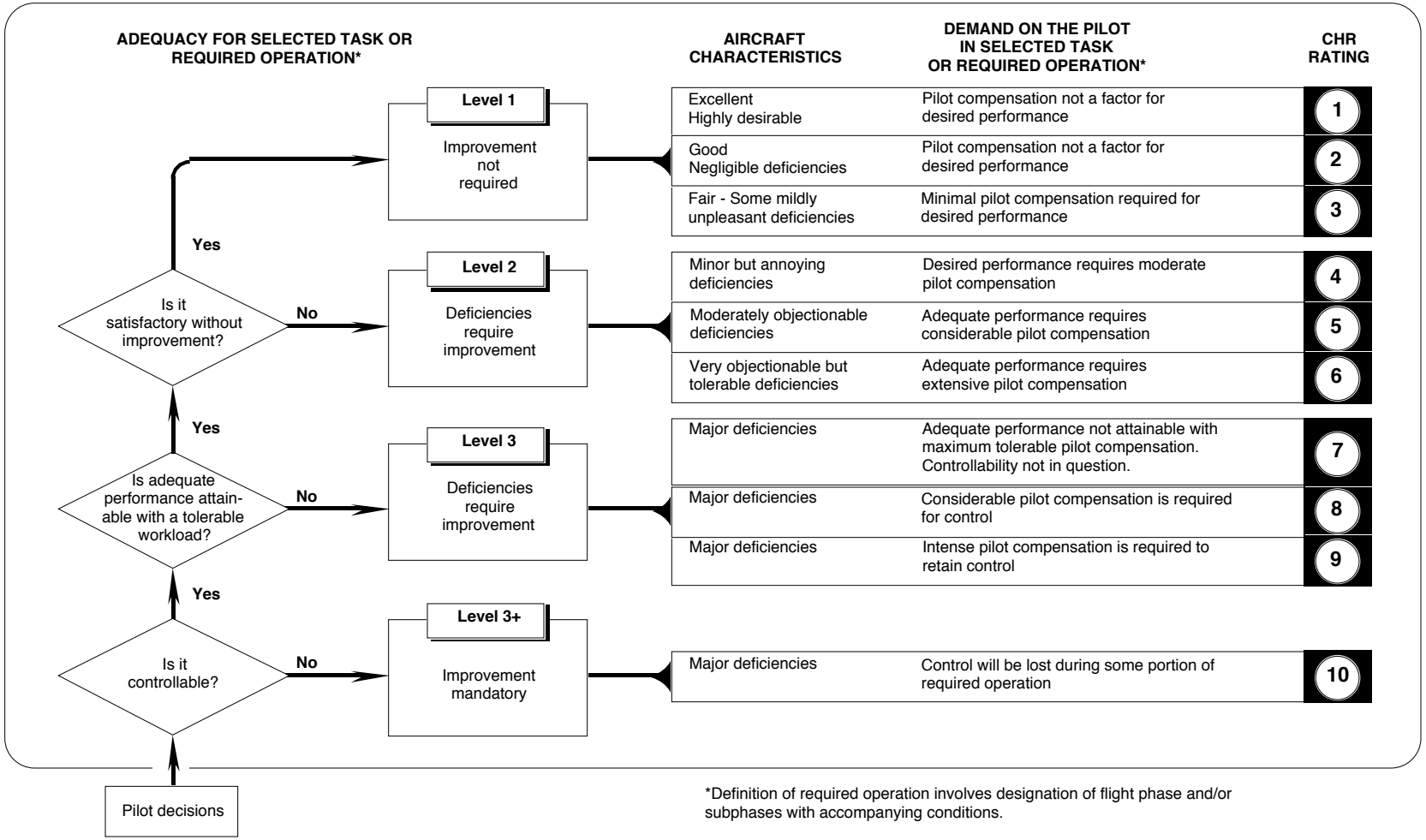


Figure C1.- Cooper-Harper Rating Scale.

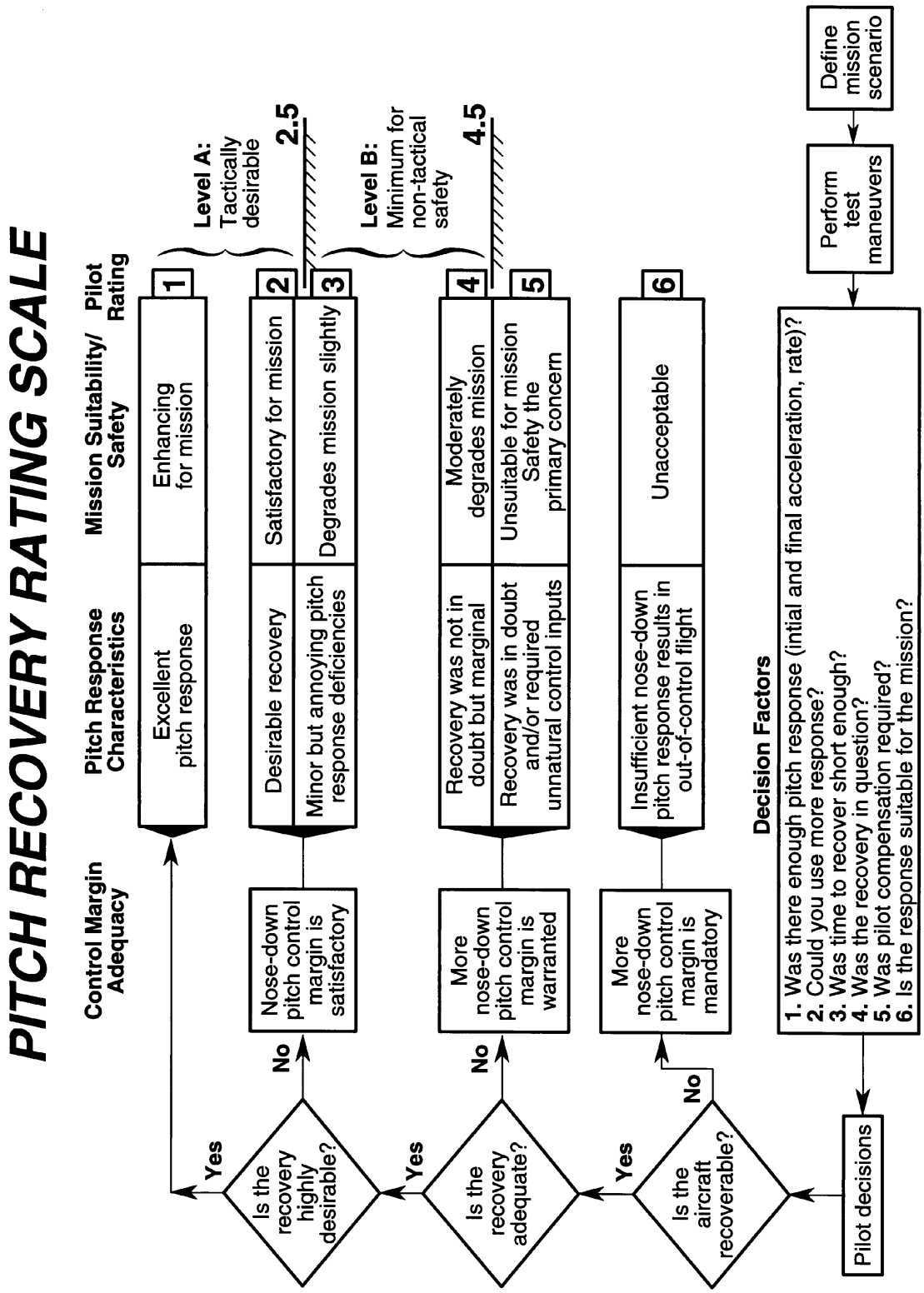


Figure C2.- Pitch Recovery Rating Scale.

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13. ABSTRACT *(Maximum 200 words)*

Under the NASA High-Alpha Technology Program the High-Alpha Research Vehicle (HARV) was used to conduct flight tests of advanced control effectors, advanced control laws, and high-alpha design guidelines for future super-maneuverable fighters. The HARV is a pre-production F/A-18 airplane modified with a multi-axis thrust-vectoring system for augmented pitch and yaw control power. Handling-Qualities flight testing at the Dryden Flight Research Center (DFRC) for the NASA-1A Control Law was conducted in the spring of 1994. Pilot comments during actual flight test maneuvers and following the maneuvers will be useful in evaluation of control law performance. Audio files containing pilot comments were retrieved from the DFRC data system and stored on the Dynamics and Control Branch (DCB) computer complex at NASA Langley Research Center (LaRC), and pilot comments were transcribed for use as a control law evaluation tool. This report briefly describes the multi-step task used to transcribe these comments and presents transcriptions of actual pilot communications for selected maneuvers using the NASA-1A control law. Documentation includes flight information, maneuver information, time intervals for which comments were retrieved, pilot comments, and pilot Cooper-Harper ratings.

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